IP/MPLS Router Module for the CBX 500 Multiservice WAN Switch

Hardware Guide

Lucent Technologies

InterNetworking Systems

Data Networking

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About This Manual

This preface provides the following guidelines for using the *IP/MPLS Router Module Hardware Guide*:

- Objectives on page xiv
- Audience on page xv
- Document Organization on page xv
- Documentation Conventions on page xv
- List of Technical Publications on page xvi
- Documentation Feedback on page xix
- How to Request Support on page xix

Objectives

This manual describes hardware installation and basic troubleshooting procedures for the Lucent Technologies IP/MPLS Router Module. It explains how to prepare your site for router module installation, unpack and install the hardware, power on the router module, perform initial software configuration, and perform routine maintenance. After completing the installation and basic configuration procedures covered in this manual, refer to the JUNOS Internet software configuration guides for information about further JUNOS software configuration.

To obtain additional information about the IP/MPLS router module—either corrections to information in this manual or information that might have been omitted from this manual—refer to the hardware release notes.

To obtain the most current version of this manual, the most current version of the hardware release notes, and other technical documentation for the IP/MPLS router module, refer to the product documentation page on the Lucent Technologies Web site, which is located at http://www.lucent.com.

To order printed copies of this manual, use the following URL to access the Lucent Bookstore:

http://www.lucentdocs.com

To obtain the most current version of other Juniper Networks technical documentation, refer to the product documentation page on the Juniper Networks Web site, which is located at http://www.juniper.net.

Audience

This manual is designed for network administrators who are installing and maintaining a Juniper Networks router, or preparing a site for router installation. It assumes a broad understanding of networks in general, the Internet in particular, networking principles, and network configuration. Any detailed discussion of these concepts is beyond the scope of this manual.

Document Organization

This manual is divided into several parts:

- Part 1, "Product Overview," provides an overview of the router module, describing its hardware components, the JUNOS Internet software, and the system architecture.
- Part 2, "Performing Initial Installation," describes how to prepare your site for router module installation, and how to unpack, install, and power on the router module. It describes requirements and specifications for the installation site, power source, wiring, and cabling. It also provides detailed safety guidelines and warnings.
- Part 3, "Maintaining Hardware, Replacing Parts, and Troubleshooting," describes how to maintain, replace, and troubleshoot the router module.

This manual also contains a complete index.

Documentation Conventions

General Conventions

This manual uses the following text conventions:

- Router and router component labels are shown in a sans serif font. In the following example, ETHERNET is the label for the Ethernet management port on the router:

  The 10/100-Mbps Ethernet RJ-45 connector is used for out-of-band management of the router and is labeled ETHERNET.

- Statements, commands, filenames, directory names, IP addresses, and configuration hierarchy levels are shown in a sans serif font. In the following example, *stub* is a statement name and [edit protocols ospf area *area-id*] is a configuration hierarchy level:

To configure a stub area, include the **stub** statement at the [edit protocols ospf area *area-id*] hierarchy level.

- In examples, text that you type literally is shown in bold. In the following example, you type the words *show chassis alarms* :

  For example, you can use the following command to get information about the source of an alarm condition:

```
user@host> show chassis alarms
```

Notes, Cautions, and Warnings

Notes, cautions, and warnings are denoted by the following symbols:

NOTE: A note indicates information that might be helpful in a particular situation or that might otherwise be overlooked.

CAUTION: A caution indicates a situation that requires careful attention. Failure to observe a cautionary note could result in minor injury or discomfort to yourself, or serious damage to the router.

WARNING: A warning indicates a potentially dangerous situation. Failure to follow the guidelines in a warning could result in severe injury or death.

List of Technical Publications

Table 1 lists the software and hardware books for Juniper Networks J-series, M-series, and T-series routers and describes the contents of each book. Table 2 lists the software and hardware books from Lucent Technologies for installing and managing the CBX 500 switch.

Table 1: Juniper Networks Technical Documentation

Book	Description
JUNOS Internet Software for J-series, M-series, and T-series Routing Platforms Configuration Guides	
Feature Guide	Provides a detailed explanation and configuration examples for several of the most complex features in the JUNOS software.

Book	Description
System Basics	Provides an overview of the JUNOS software and describes how to install and upgrade the software. This manual also describes how to configure system management functions and how to configure the chassis, including user accounts, passwords, and redundancy.
Network Interfaces and Class of Service	Provides an overview of the network interface and class-of-service functions of the JUNOS software and describes how to configure the network interfaces on the router.
MPLS Applications	Provides an overview of traffic engineering concepts and describes how to configure traffic engineering protocols.
Multicast Protocols	Provides an overview of multicast concepts and describes how to configure multicast routing protocols.
Network Management	Provides an overview of network management concepts and describes how to configure various network management features, such as SNMP, accounting options, and cflowd.
Policy Framework	Provides an overview of policy concepts and describes how to configure routing policy, firewall filters, and forwarding options.
Routing Protocols	Provides an overview of routing concepts and describes how to configure routing, routing instances, and unicast routing protocols.
Services Interfaces	Provides an overview of the services interfaces functions of the JUNOS software and describes how to configure the services interfaces on the router.
VPNs	Provides an overview and describes how to configure Layer 2 and Layer 3 virtual private networks (VPNs), virtual private LAN service (VPLS), and Layer 2 circuits. Provides configuration examples.
JUNOS References	
Network and Services Interfaces Command Reference	Describes the JUNOS Internet software operational mode commands you use to monitor and troubleshoot network and services interfaces on Juniper Networks routing platforms.
Protocols, Class of Service, and System Basics Command Reference	Describes the JUNOS Internet software operational mode commands you use to monitor and troubleshoot most aspects of Juniper Networks routing platforms
System Log Messages Reference	Describes how to access and interpret system log messages generated by JUNOS software modules and provides a reference page for each message.
JUNOScript API Documentation	
JUNOScript API Guide	Describes how to use the JUNOScript application programming interface (API) to monitor and configure Juniper Networks routers.
JUNOScript API Configuration Reference	Provides reference pages for the configuration tags in the JUNOScript API.
JUNOScript API Operational Reference	Provides reference pages for the operational tags in the JUNOScript API.
JUNOS Comprehensive Index and Glossary	
Comprehensive Index and Glossary	Provides a complete index of all JUNOS Internet software books and the *JUNOScript API Guide*. Also provides a comprehensive glossary.
Hardware Documentation	

Book	Description
Hardware Guide	Describes how to install, maintain, and troubleshoot routers and router components. Each platform has its own hardware guide.
PIC Guide	Describes the router Physical Interface Cards (PICs). Each router platform has its own PIC guide.
JUNOScope Documentation	
JUNOScope Software User Guide	Describes the JUNOScope software graphical user interface (GUI), how to install and administer the software, and how to use the software to manage router configuration files and monitor router operations.
J-series Services Router Documentation	
J-series Services Router User Guide	Contains instructions for installing, configuring, and managing a J-series Services Router. The guide explains how to prepare your site for installation, unpack and install the hardware, power on the router, configure secure routing, monitor network operations, and perform routine maintenance.
Release Notes	
JUNOS Internet Software Release Notes	Provide a summary of new features for a particular software release. Software release notes also contain corrections and updates to published JUNOS and JUNOScript manuals, provide information that might have been omitted from the manuals, and describe upgrade and downgrade procedures.
Hardware Release Notes	Describe the available documentation for the router platform and summarize known problems with the hardware and accompanying software. Each platform has its own release notes.
JUNOScope Software Release Notes	Contain corrections and updates to the published JUNOScope manual, provide information that might have been omitted from the manual, and describe upgrade and downgrade procedures.
JUNOS for J-series Services Routers Release Notes	Briefly describe Services Router features, identify known software problems, and provide upgrade and downgrade instructions

Table 2: Lucent Technologies Technical Documentation

Book	Description
CBX 500 Multiservice WAN Switch Hardware Installation Guide	Describes how to install and set up the CBX 500 switch hardware, replace hardware modules, and interpret LED status indicators.
Network Management Station Installation Guide	Describes how to install NavisCore network management software and supporting applications on the Network Management Station (NMS). You manage a CBX 500 switch through the NMS NavisCore software.
Getting Started User's Guide	Describes how to configure and manage NavisCore, network maps, and Lucent switches. It also describes how to add third-party objects to the map and access them through NavisCore.
Switch Module Configuration Guide	Describes the processor and input/output modules (IOMs) on the switch, and the configuration of physical ports, timing, and other attributes through NavisCore.

Book	Description
Frame Relay Services Configuration Guide for CBX 3500, CBX 500, and B-STDX 9000	Describes how to configure frame relay WAN services on the supported switch platforms.
ATM Services Configuration Guide for CBX 3500, CBX 500, GX 550, and B-STDX 9000	Describes how to configure ATM WAN services on the supported switch platforms.
IP Services Configuration Guide for CBX 500 and B-STDX 9000	Describes how to configure IP WAN services on the supported switch platforms.
Console Command User's Reference	Contains reference lists and describes the switch console commands.
Diagnostics User's Guide	Describes how to monitor and diagnose problems in your Navis EMS-CBGX switch network.
Navis EMS-CBGX Installation and Administration Guide	Describes prerequisite tasks, hardware and software requirements, and instructions for installing and upgrading Solaris and Navis EMS-CBGX on the NMS.
Navis EMS-CBGX Graphical User Interface Guide	Describes how to start the Navis EMS-CBGX client on Windows and Solaris. It also provides a description of the Navis EMS-CBGX window components, how to access network and map configuration options, and instructions for customizing Navis EMS-CBGX.
Getting Started User's Guide	Describes how to configure and manage Navis EMS-CBGX, network maps, and Lucent switches. It also describes how to add third-party objects to the map and access them through Navis EMS-CBGX.

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Part 1
Product Overview

- System Overview on page 3
- Hardware Component Overview on page 5
- JUNOS Internet Software Overview on page 17
- System Architecture Overview on page 27

Chapter 1
System Overview

This chapter provides an overview of the IP/MPLS router module, discussing the following topics:

- System Description on page 3
- Safety Requirements, Warnings, and Guidelines on page 3

System Description

The IP/MPLS router module is a complete routing system that provides ATM, Ethernet, and IP services for large networks and network applications, such as those supported by Internet service providers (ISPs). Application-specific integrated circuits (ASICs), a definitive part of the router module design, enable the router module to forward data at the high speeds demanded by current network media. The IP/MPLS router module is designed exclusively for installation in the Lucent Technologies CBX 500 switch.

The router module provides two Gigabit Ethernet ports and two OC12/STM4 ATM ports.

The router module architecture cleanly separates control operations from packet forwarding operations, which helps to eliminate processing and traffic bottlenecks. The router module performs control operations and runs JUNOS Internet software to handle routing protocols, traffic engineering, policy, policing, monitoring, and configuration management. Forwarding operations in the router module are performed by the packet forwarding engine, which consists of hardware, including ASICs, designed by Juniper Networks.

Safety Requirements, Warnings, and Guidelines

To avoid harm to yourself or the router module as you install and maintain it, you must follow the guidelines for working with and near electrical equipment, as well as the safety procedures for working with Internet routers. For a discussion of how to make the installation site a safe environment, see “Preparing to Install the Router Module” on page 35. For a list of safety warnings, see “Safety and Regulatory Compliance Information” on page 75 and particularly “Electrical Safety Guidelines and Warnings” on page 81. However, providing an exhaustive set of guidelines for working with electrical equipment is beyond the scope of this manual.

Chapter 2

Hardware Component Overview

This chapter provides an overview of the hardware components in the IP/MPLS router module:

- Physical Specifications on page 5
- Packet Forwarding Engine on page 8
- Routing Engine on page 8
- Router Module Interface Ports on page 11

Physical Specifications

The router module is a rigid sheet metal structure that houses the other hardware components. The router module is 16.0 in. (40.6 cm) high and 13.1 in. (33.3 cm) deep. The two mounting ears (one each on the top and bottom) extend the height to 17.2 in. (43.7 cm). The width of 2.1 in. (5.3 cm) enables side-by-side installation of six IP/MPLS router modules in a single CBX 500 switch. You can install a router module in any two adjacent CBX 500 slots except the leftmost slot (slot 3).

The router module is hot-insertable (this means that you do not need to power off the switch first). However, it is not hot-removable—before you remove it from the switch, you must shut it down from the JUNOS software command line or by using the offline/online button on the front panel.

Figure 1 and Figure 2 show two views of the router module.

Figure 1: Front of Router Module

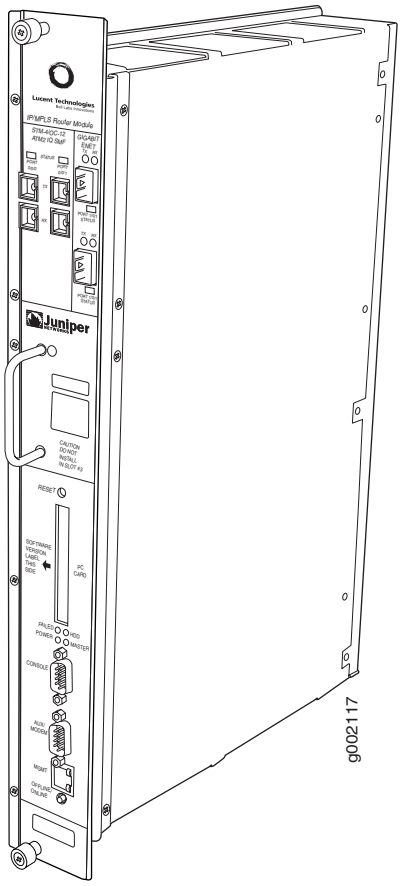
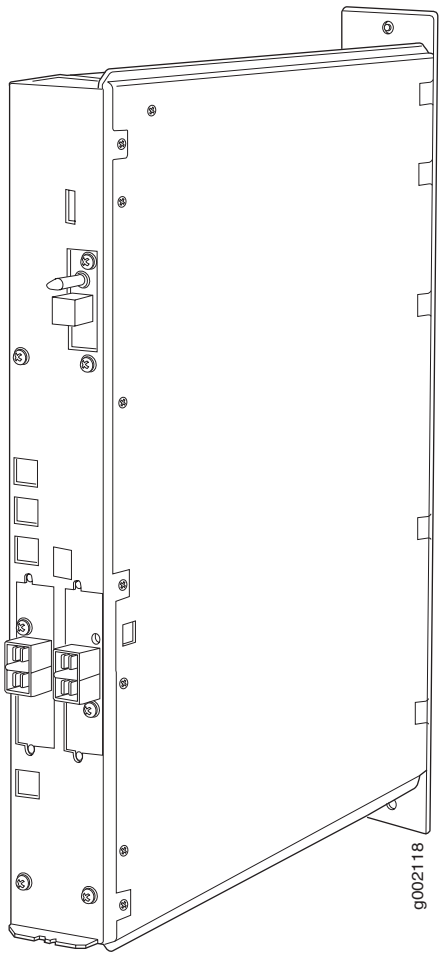


Figure 2: Rear of Router Module



WARNING: Static electricity can damage the router module. Before handling the router module, put on the antistatic wrist strap that is provided in the router module accessory kit, and connect it to the grounding jack located on the front of the switch. For more information about using the wrist strap, see the *CBX 500 Multiservice WAN Switch Hardware Installation Guide* from Lucent Technologies.

For further safety information, see "Safety and Regulatory Compliance Information" on page 75.

Table 3 summarizes physical specifications for the router module.

Table 3: Router Module Physical Specifications

Description	Value
Height	16.0 in. (40.6 cm); 17.2 in. (43.7 cm) with mounting ears
Width	2.1 in. (5.3 cm)
Depth	13.1 in. (33.3 cm)
Weight, maximum configuration	13.6 lb (6.2 kg)
Thermal output	256 BTU

Packet Forwarding Engine

The packet forwarding engine is a multicomponent system that uses application-specific integrated circuits (ASICs) to perform Layer 2 and Layer 3 packet switching, route lookups, and packet forwarding.

Routing Engine

The routing engine is an Intel-based PCI platform that runs JUNOS Internet software. Software processes that run on the routing engine maintain the routing tables, manage the routing protocols used on the router module, control the router module's interfaces, control other router module components, and provide the interface for system management and user access to the router module.

For a more detailed description of the routing engine's role in router module architecture, see "Routing Engine Architecture" on page 29.

Routing Engine Components

The routing engine is a two-board system with the following components:

- CPU—Runs JUNOS Internet software to maintain the router module's routing tables and routing protocols. It has a Pentium-class processor.
- SDRAM—Provides 768 MB of storage for the routing and forwarding tables and for other routing engine processes.
- Internal flash disk—Provides 256 MB of primary storage. It can accommodate software images, configuration files, and microcode.
- Hard disk—Provides secondary storage for log files and memory dumps, and can reboot the system if the flash disk fails.
- PC card slot—Accepts a removable PC card, which stores software images for system upgrades.
- Four LEDs—A green LED labeled HDD, a blue LED labeled MASTER, a red LED labeled FAILED, and a green LED labeled POWER indicate routing engine status. Table 4 describes the LED states.
- Interfaces for out-of-band management access—Provide information about routing engine status to devices (console, laptop, or terminal server) that can be attached to access ports located on the router module.
- I2C/EEPROM—Stores the serial number of the routing engine.
- Reset button—Reboots the routing engine when pressed.
- Offline/online button—Powers off the routing engine when pressed.

Table 4: States for Routing Engine LEDs

Label	Color	State	Description
HDD	Green	Blinking	There is read/write activity on the PC card.
MASTER	Blue	On steadily	Routing engine is functioning as master. On an IP/MPLS router module, this LED is always lit.
FAILED	Red	On steadily	Routing engine is not operational.
POWER	Green	On steadily	Routing engine is running normally.

Routing Engine Management Ports

On the bottom half of the router module's faceplate are ports for connecting the routing engine to one or more external devices on which system administrators can issue JUNOS command-line interface (CLI) commands to manage the routing engine.

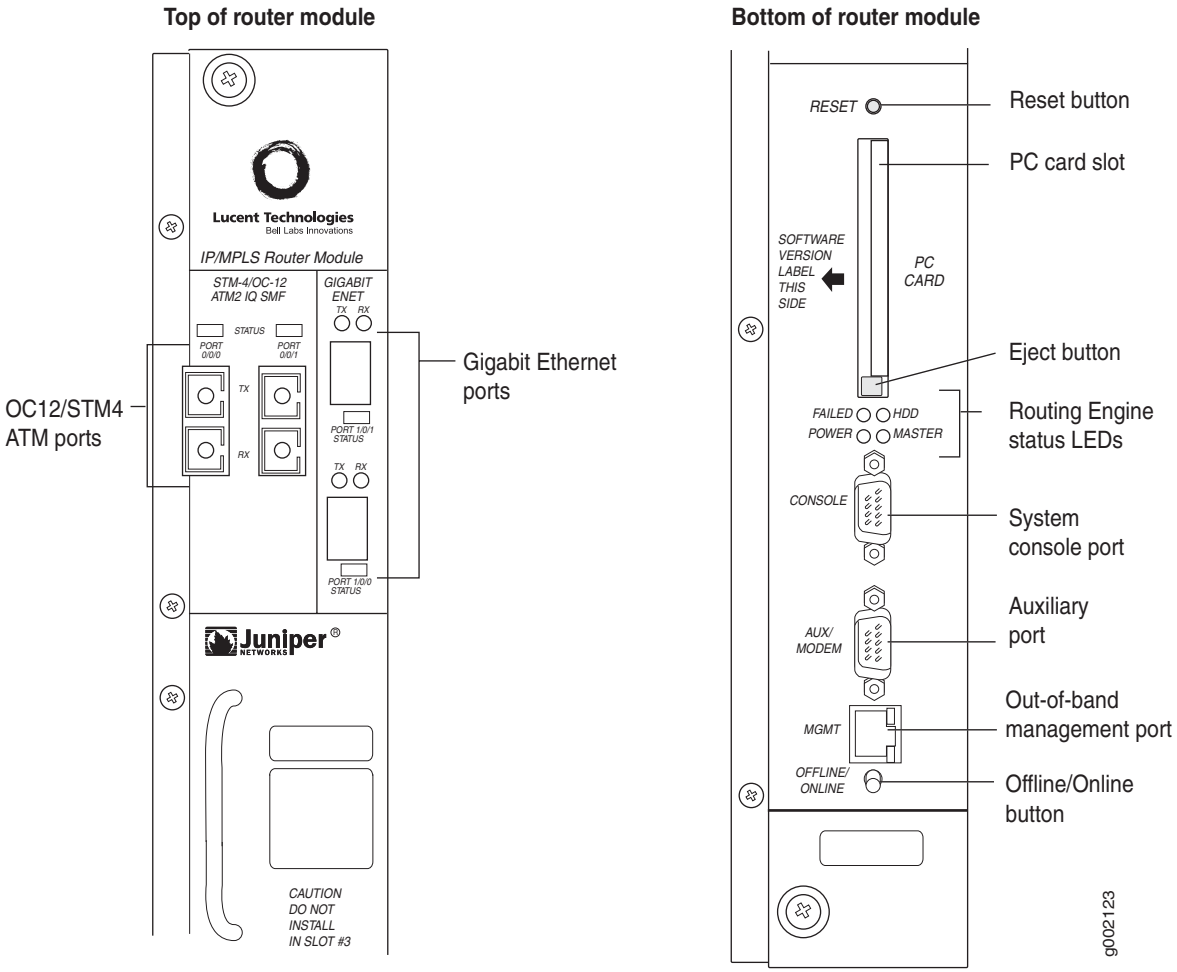
The ports are labeled and function as follows:

- CONSOLE—Connects the routing engine to a system console through an RS-232 (EIA-232) serial cable.
- AUX/MODEM— Connects the routing engine to a laptop, modem, or other auxiliary device through an RS-232 (EIA-232) serial cable.
- MGMT—Connects the routing engine through an Ethernet connection to a management LAN (or any other device that plugs into an Ethernet connection) for out-of-band management. The port uses an autosensing RJ-45 connector to support both 10- and 100-Mbps connections. Two small LEDs on the right edge of the port indicate the connection in use: the amber LED flashes in correspondence with activity for a 10-Mbps connection, and the green LED flashes in correspondence with activity for a 100-Mbps connection.

For information about the pinouts for the connectors, see “Cable Connector Pinouts” on page 93.

Figure 3 shows the routing engine management ports.

Figure 3: Routing Engine Management Ports



Router Module Interface Ports

This section describes the features, specifications, and optical interface support of the router module interface ports (OC12/STM4 ATM and Gigabit Ethernet). This section also describes the small form-factor pluggables (SFPs) that are supported by the Gigabit Ethernet ports.

OC12/STM4 ATM Ports

The following tables describe the features, specifications, and optical interface support for the two OC12/STM4 ATM ports.

Table 5: Features and Specifications for OC12/STM4 ATM Ports

Description	■ Two OC12/STM4 ATM ports ■ Intelligent queuing (IQ) supports fine-grained queuing per logical interface ■ Conforms to ANSI T1.105-1991 and T1E1.2/93-020R1 ■ ATM standards compliant ■ Alarm and event counting and detection ■ Compatible with well-known ATM switches ■ ATM switch ID, which displays the switch IP address and local interface name of the adjacent Fore ATM switches
Hardware features	■ ASIC-based packet segmentation and reassembly (SAR) management and output port queuing ■ 64-MB SDRAM memory for ATM SAR ■ Packet buffering, Layer 2 parsing
Software features	■ Multiprotocol Label Switching (MPLS) circuit cross-connect for leveraging ATM access networks ■ User-configurable virtual circuit (VC) and virtual path (VP) support ■ Support for idle cell or unassigned cell transmission ■ OAM Fault Management processes Alarm Indication Signal (AIS), Remote Defect Indicator (RDI), and loop cells ■ Point-to-point and point-to-multipoint mode Layer 2 counters per VC and per VP ■ Local and remote loopback ■ ATM Inverse ARP, which enables routers to automatically learn the IP address of the router on the far end of an ATM PVC ■ Simple Network Management Protocol (SNMP): ▪ Management Information Base (MIB) 2 (RFC 1213) ▪ ATM MIB (RFC 1695) ▪ SONET MIB ■ Unspecified bit rate (UBR), non-real-time variable bit rate (VBR), and constant bit rate (CBR) traffic shaping ■ Per-VC or per-VP traffic shaping ■ Support for F4 OAM cells ■ Support for 16-bit VCI range
Cables and connectors	■ Duplex SC/PC connector (RX and TX)

LEDs	One tricolor LED per port: ■ Off—Not enabled ■ Green—Online with no alarms or failures ■ Amber—Online with alarms for remote failures ■ Red—Active with a local alarm; router has detected a failure
Alarms, errors, and events	■ Alarm Indication Signal (AIS-L, AIS-P) ■ Bit Error Rate Signal Degrade (BERR-SD), Bit Error Rate Signal Fail (BERR-SF) ■ Bit Interleaved Parity Errors B1, B2, B3 (CV-S, CV-L, CV-P) ■ Errored Seconds (ES-S, ES-L, ES-P), Far-end Bit Errors REI-L, REI-P (CV-LFE, CV-PFE), Far-end Errored Seconds (ES-LFE, ES-PFE), Far-end Severely Errored Seconds (SES-LFE, SES-PFE), Far-end Unavailable Seconds (UAS-LFE, UAS-PFE) ■ Loss of Cell Delineation (LoC), Loss of Frame (LoF), Loss of Pointer (LoP-P), Loss of Signal (LoS) ■ Payload Mismatch (PLM-P), Payload Unequipped (UNEQ-P) ■ Remote Defect Indication (RDI-L, RDI-P) ■ Severely Errored Framing (SEF), Severely Errored Framing Seconds (SEFS-S), Severely Errored Seconds (SES-S, SES-L, SES-P), Unavailable Seconds (UAS-L, UAS-P)

Table 6: Optical Interface Support for OC12/STM4 ATM Ports

Specification	Value
Optical interface	Single-mode, intermediate reach (Bellcore GR-253 compliant) with SC/PC duplex connector (maximum distance 9.3 miles/15 km)
Wavelength	1274 through 1356 nm
Average launch power	–15 through –8 dBm
Receiver saturation	–8 dBm
Receiver sensitivity	–28 dBm

Gigabit Ethernet Ports

The following tables describe the features, specifications, and optical interface support for the two Gigabit Ethernet ports.

Table 7: Features and Specifications for Gigabit Ethernet Ports

Description	■ Two Gigabit Ethernet ports ■ Support large Ethernet frame sizes for more efficient throughput across the intra-POP network
Hardware features	■ High-performance throughput on all ports at speeds up to 1 Gbps ■ Autonegotiation between Gigabit Ethernet circuit partners ■ Full-duplex mode ■ Maximum transmission units (MTUs) of up to 9192 bytes
Software features	■ Virtual Router Redundancy Protocol (VRRP) support ■ 802.1Q virtual LANs (VLANs) support ■ 64 source MAC filters per VLAN and 1024 source MAC filters per port ■ 960 destination MAC filters per port ■ MAC accounting and policing—Dynamic local address learning of source MAC addresses
Cables and connectors	■ You can use 1000Base-T, 1000Base-SX, 1000Base-LX, and 1000Base-LH SFPs. ■ SX, LX, and LH small form factor pluggable transceivers (SFPs): ▪ Duplex LC/PC connector (RX and TX) ■ 1000Base-T SFPs: ▪ Connector: Four-pair, category 5 shielded twisted-pair connectivity through an RJ-45 connector ▪ Pinout: MDI crossover ▪ Length: 328-ft/100-m
LEDs	Port LEDs, one pair per port: ■ RX (link)—If green, the port is online; if there is no light, the port is down ■ TX (activity)—If flashing green, the port is receiving data; if there is no light, the port might be on, but is not receiving data Status LEDs, one bicolor: ■ Off—port is not enabled ■ Green—port is operating normally ■ Red—port has an error or failure

Table 8: Optical Interface Support for Gigabit Ethernet Ports

PIC Type	SX Transceiver	LX Transceiver	LH Transceiver
Optical interface	656-ft/200-m reach on 62.5/125-micrometer multimode fiber (MMF) 1640-ft/500-m reach on 50/125-micrometer MMF	6.2-mile/10-km reach on 9/125-micrometer single-mode fiber (SMF) 1804.5-ft/550-m reach on 62.5/125 and 50/125-micrometer MMF	49.5-mile/70-km reach on 8.2-micrometer SMF
Wavelength	830 through 860 nm	1275 through 1350 nm	1480 through 1580 nm
Average launch power	–9.5 through –4 dBm	–9.5 through –3 dBm	–3 through +3 dBm
Receiver saturation	–3 dBm	–3 dBm	–3 dBm
Receiver sensitivity	–18 dBm	–20.5 dBm	–23 dBm

SFPs

SFPs are optical transceivers that you can install in and remove from the router module. Each Gigabit Ethernet port supports SX, LX, LH, and 1000Base-T SFPs. The router module includes two SFPs of either the SX, LX, or LH type depending on the configuration that you ordered. (1000Base-T SFPs are not provided.)

Chapter 3

JUNOS Internet Software Overview

The JUNOS Internet software is especially designed for the large production networks typically supported by Internet service providers (ISPs). It incorporates Internet Protocol (IP) routing software and software for management of interfaces, networks, and the router module.

The JUNOS Internet software runs on the routing engine. The software consists of processes that support Internet routing protocols, control the router module's interfaces and the router module itself, and provide an interface for system management. The processes run on top of a kernel that coordinates the communication among processes and has a direct link to the packet forwarding engine software.

Use the JUNOS Internet software to configure the routing protocols that run on the router module and the properties of router module interfaces. After you have activated a software configuration, use the JUNOS Internet software to monitor the protocol traffic passing through the router module and to troubleshoot protocol and network connectivity problems.

For additional information about the JUNOS Internet software, including its security features and a list of the industry standards it supports, see the *JUNOS System Basics Configuration Guide*. For complete information about configuring the software (including examples), see the JUNOS Internet software configuration guides.

NOTE: The router module supports Release 7.0 and later versions of the JUNOS Internet software.

This chapter discusses the following topics:

- Routing Engine Software Components on page 18
- Tools for Accessing and Configuring the Software on page 24
- Tools for Monitoring the Software on page 24
- Upgrading Software on page 25

Routing Engine Software Components

The routing engine software consists of several software processes that control router module functions and a kernel that coordinates communication among the processes, as described in the following sections:

- Routing Protocol Process on page 18
- VPNs on page 22
- Interface Process on page 23
- Chassis Process on page 23
- SNMP and MIB II Processes on page 23
- Management Process on page 24
- Routing Engine Kernel on page 24

Routing Protocol Process

The JUNOS software routing protocol process controls the routing protocols that run on the router module. The routing protocol process starts all configured routing protocols and handles all routing messages. It consolidates the routing information learned from all routing protocols into common routing tables. From this routing information, the routing protocol process determines the active routes to network destinations and installs these routes in the routing engine's forwarding table. Finally, the routing protocol process implements the routing policies you specify, which determine how routing information is transferred between the routing protocols and the routing table.

This section discusses the following topics:

- IPv4 Routing Protocols on page 18
- IPv6 Routing Protocols on page 20
- Routing and Forwarding Tables on page 21
- Routing Policy on page 22

For complete information about routing concepts, see the JUNOS Internet software configuration guides.

IPv4 Routing Protocols

The JUNOS Internet software implements full IP routing functionality, providing support for IP version 4 (IPv4). The routing protocols are fully interoperable with existing IP routing protocols and provide the scale and

control necessary for the Internet core. The software provides support for the following routing and traffic engineering protocols:

- Unicast routing protocols
  - BGP—Border Gateway Protocol, version 4, is an Exterior Gateway Protocol (EGP) that guarantees loop-free exchange of routing information between routing domains (also called autonomous systems). BGP, in conjunction with JUNOS routing policy, provides a system of administrative checks and balances that can be used to implement peering and transit agreements.
  - ICMP—Internet Control Message Protocol router discovery is a method that hosts can use to discover the addresses of operational routers on a subnet.
  - IS-IS—Intermediate System-to-Intermediate System is a link-state interior gateway protocol (IGP) for IP networks that uses the shortest-path-first algorithm (SPF algorithm, also called the Dijkstra algorithm) to determine routes.
  - OSPF—Open Shortest Path First, version 2, is an IGP developed for IP networks by the Internet Engineering Task Force (IETF). OSPF is a link-state protocol that makes routing decisions based on the SPF algorithm.
  - RIP—Routing Information Protocol, version 2, is an IGP for IP networks based on the Bellman-Ford algorithm. RIP is a distance-vector protocol. RIP dynamically routes packets between a subscriber and a service provider without the subscriber having to configure BGP or to participate in the service provider's IGP discovery process.
- Multicast routing protocols
  - DVMRP—Distance Vector Multicast Routing Protocol is a dense-mode (flood-and-prune) multicast routing protocol.
  - IGMP—Internet Group Management Protocol, versions 1 and 2, is used to manage membership in multicast groups.
  - MSDP—Multicast Source Discovery Protocol enables multiple PIM sparse mode domains to be joined. A rendezvous point (RP) in a PIM sparse mode domain has a peering relationship with an RP in another domain, thereby discovering multicast sources from other domains.
  - PIM sparse mode and dense mode—Protocol-Independent Multicast is a multicast routing protocol used to route traffic to multicast groups that might span wide-area and interdomain internetworks. In PIM sparse

mode, routers explicitly join and leave multicast groups. PIM dense mode is a flood-and-prune protocol.

- SAP/SDP—Session Announcement Protocol and Session Description Protocol handle conference session announcements.

- MPLS application protocols
  - LDP—Label Distribution Protocol provides a mechanism for distributing labels in nontraffic-engineered applications. LDP allows routers to establish label-switched paths (LSPs) through a network by mapping network-layer routing information directly to data-link layer switched paths. LSPs created by LDP can also traverse LSPs created by Resource Reservation Protocol (RSVP).
  - MPLS—Multiprotocol Label Switching enables you to configure LSPs through a network either manually or dynamically. You can control how traffic traverses the network by directing it through particular paths, rather than relying on an IGP's least-cost algorithm to choose a path. VPLS (Virtual Private LAN Services) and other tunnel services are not supported.
  - RSVP—Resource Reservation Protocol, version 1, provides a mechanism for engineering network traffic patterns that is independent of the shortest path determined by a routing protocol. RSVP itself is not a routing protocol, but is designed to operate with current and future unicast and multicast routing protocols. JUNOS RSVP software supports dynamic signaling for MPLS LSPs.

IPv6 Routing Protocols

The JUNOS Internet software implements full IP routing functionality, providing support for IP version 6 (IPv6). The routing protocols are fully interoperable with existing IP routing protocols and provide the scale and control necessary for the Internet core. The software provides support for the following unicast routing protocols:

- BGP—Border Gateway Protocol, version 4, is an EGP that guarantees loop-free exchange of routing information between routing domains (also called autonomous systems). BGP, in conjunction with JUNOS routing policy, provides a system of administrative checks and balances that can be used to implement peering and transit agreements.

- ICMP—Internet Control Message Protocol router discovery is a method that hosts can use to discover the addresses of operational routers on a subnet.

- IS-IS—Intermediate System-to-Intermediate System is a link-state interior gateway protocol (IGP) for IP networks that uses the shortest-path-first algorithm (SPF algorithm, also called the Dijkstra algorithm) to determine routes.

- OSPF—Open Shortest Path First, version 3 (OSPFv3), supports version 6 of the Internet Protocol (IPv6). The fundamental mechanisms of OSPF such as

flooding, Designated Router (DR) election, area based topologies, and the Shortest Path First (SPF) calculations remain unchanged. Some differences exist either because changes in protocol semantics between IPv4 and IPv6, or to handle the increased address size of IPv6.

- RIP—Routing Information Protocol, version 2, is an IGP for IP networks based on the Bellman-Ford algorithm. RIP is a distance-vector protocol. RIP dynamically routes packets between a subscriber and a service provider without the subscriber having to configure BGP or to participate in the service provider's IGP discovery process.

Routing and Forwarding Tables

The primary function of the JUNOS routing protocol process is maintaining routing tables and using the information in them to determine active routes to network destinations. It copies information about the active routes into the routing engine's forwarding table, which the JUNOS kernel copies to the packet forwarding engine.

By default, the routing protocol process maintains the following routing tables and uses the information in each table to determine active routes to network destinations:

- Unicast routing table—Stores routing information for all unicast protocols running on the router module, including BGP, IS-IS, OSPF, and RIP. You can also configure additional routes, such as static routes, for inclusion in the routing table. The unicast routing protocols use the routes in this table when advertising routing information to their neighbors.

  In the unicast routing table, the routing protocol process designates routes with the lowest preference values as active. By default, a route's preference value is simply a function of how the routing protocol process learned about the route. You can modify the default preference value by setting routing policies and configuring other software parameters. See "Routing Policy" on page 22.

- Multicast routing table (cache)—Stores routing information for all multicast protocols running on the router module, including DVMRP and PIM. You can configure additional routes for inclusion in the routing table.

  In the multicast routing table, the routing protocol process uses traffic flow and other parameters specified by the multicast routing protocol algorithms to select active routes.

- MPLS routing table—Stores MPLS label information.

For unicast routes, the routing protocol process determines active routes by choosing the most preferred route, which is the route with the lowest preference value. By default, the route's preference value is simply a function of how the routing protocol process learned about the route. You can modify the default preference value using routing policy and with software configuration parameters.

For multicast traffic, the routing protocol process determines active routes based on traffic flow and other parameters specified by the multicast routing protocol

algorithms. The routing protocol process then installs one or more active routes to each network destination in the routing engine's forwarding table.

You can configure additional routing tables to meet your requirements, as described in the *JUNOS Routing Protocols Configuration Guide*.

Routing Policy

By default, all routing protocols place their routes in the routing table. When advertising routes, the routing protocols, by default, advertise only a limited set of routes from the routing table. Specifically, each routing protocol exports only the active routes that were learned by that protocol. In addition, IGPs (IS-IS, OSPF, and RIP) export the direct (interface) routes for the interfaces on which the protocol is explicitly configured.

For each routing table, you can affect the routes that a protocol places in the table and the routes from the table that the protocol advertises by defining one or more routing policies and then applying them to the specific routing protocol.

Routing policies applied when the routing protocol places routes in the routing table are called *import policies* because the routes are being imported into the routing table. Policies applied when the routing protocol is advertising routes that are in the routing table are called *export policies* because the routes are being exported from the routing table. In other words, the terms import and export are used with respect to the routing table.

Routing policy enables you to control (filter) which routes are imported into the routing table and which routes are exported from the routing table. Routing policy also allows you to set the information associated with a route as it is being imported into or exported from the routing table. Routing policies applied to imported routes control the routes used to determine active routes, whereas policies applied to exported routes control which routes a protocol advertises to its neighbors.

You implement routing policy by defining policies. A policy specifies the conditions to use to match a route and the action to perform on the route when a match occurs. For example, when a routing table imports routing information from a routing protocol, a routing policy might modify the route's preference, mark the route with a color to identify it for later manipulation, or prevent the route from even being installed in a routing table. When a routing table exports routes to a routing protocol, a policy might assign metric values, modify the BGP community information, tag the route with additional information, or prevent the route from being exported altogether. You also can define policies for redistributing the routes learned from one protocol into another protocol.

VPNs

The JUNOS software supports several types of VPNs:

- Layer 2 VPNs—A Layer 2 VPN links a set of sites sharing common routing information, and whose connectivity is controlled by a collection of policies. A Layer 2 VPN is not aware of routes within a customer's network. It simply

provides private links between a customer's sites over the service provider's existing public Internet backbone.

- Layer 3 VPNs—A Layer 3 VPN links a set of sites that share common routing information, and whose connectivity is controlled by a collection of policies. A Layer 3 VPN is aware of routes within a customer's network, requiring more configuration on the part of the service provider than a Layer 2 VPN. The sites that make up a Layer 3 VPN are connected over a service provider's existing public Internet backbone.

- Interprovider VPNs—An interprovider VPN supplies connectivity between two VPNs in separate autonomous systems (ASs). This functionality could be used by a VPN customer with connections to several various ISPs, or different connections to the same ISP in various geographic regions.

- Carrier-of-Carrier VPNs—Carrier-of-carrier VPNs allow a VPN service provider to supply VPN service to a customer who is also a service provider. The latter service provider supplies Internet or VPN service to an end customer.

Interface Process

The JUNOS interface process manages the physical interface devices and logical interfaces on the router module. It implements the JUNOS command-line interface (CLI) commands and configuration statements that you use to specify interface properties such as the interface type (such as ATM), encapsulation, and interface-specific properties. You can configure both interfaces that are currently active and interfaces that might be installed later.

The JUNOS interface process communicates with the interface process in the packet forwarding engine through the JUNOS kernel, enabling the JUNOS Internet software to track the status and condition of router module interfaces.

Chassis Process

The JUNOS chassis process allows you to configure and control the properties of the router module, including conditions that trigger alarms and clock sources. The chassis process communicates directly with a chassis process in the JUNOS kernel.

SNMP and MIB II Processes

The JUNOS Internet software supports the Simple Network Management Protocol (SNMP), versions 1, 2, and 3, which provides a mechanism for monitoring the state of the router module. This software is controlled by the JUNOS SNMP and Management Information Base (MIB) II processes, which consist of an SNMP master agent and a MIB II agent.

Management Process

The management process starts all the other JUNOS software processes and the CLI when the router module boots. It monitors the running JUNOS processes and makes all reasonable attempts to restart any process that terminates.

Routing Engine Kernel

The routing engine kernel provides the underlying infrastructure for all JUNOS software processes. It also provides the link between the routing tables maintained by the routing protocol process and the forwarding table maintained by the routing engine. Additionally, it coordinates communication with the packet forwarding engine, which primarily involves synchronizing the packet forwarding engine's forwarding table with the master forwarding table maintained by the routing engine.

Tools for Accessing and Configuring the Software

The JUNOS CLI is the primary tool for accessing and controlling the JUNOS Internet software. You use it when accessing the router module through the console or a connection to an out-of-band management network. The CLI includes commands for configuring router module hardware, the JUNOS Internet software, and network connectivity.

The JUNOS CLI is a straightforward command interface. You type commands on a single line and enter the commands by pressing the Enter key. The CLI provides command help and command completion, as well as Emacs-style keyboard sequences for moving around on a command line and scrolling through a buffer that contains recently executed commands. For more information about the CLI, see the *JUNOS System Basics Configuration Guide*.

Tools for Monitoring the Software

In addition to commands for configuring router module hardware and software, the CLI includes commands for monitoring and troubleshooting hardware, software, routing protocols, and network connectivity. CLI commands display information from routing tables, information specific to routing protocols, and information about network connectivity derived from the ping and traceroute utilities.

You can also use the JUNOS Internet software implementation of SNMP to monitor router modules. The SNMP software consists of an SNMP master agent and a MIB II agent. It provides full support for MIB II SNMP version 1 traps and version 2 notifications, SNMP version 1 Get and GetNext requests, and version 2 GetBulk requests. For more information about SNMP, see the *JUNOS Network Management Configuration Guide*.

The software also supports tracing and logging operations, which you can use to track normal router module operations, error conditions, and the packets that the router module generates or forwards. Logging operations use a syslog-like mechanism to record systemwide, high-level events such as interfaces going up or down and user logins on the router module. Tracing operations record more

detailed information about the operation of routing protocols, such as the various types of routing protocol packets sent and received, and routing policy actions.

Upgrading Software

The router module is delivered with the JUNOS Internet software preinstalled. To upgrade the software, you use CLI commands to copy a set of software images over the network to memory storage on the routing engine. The JUNOS Internet software set consists of several images provided in individual packages or as a bundle. You normally upgrade all packages simultaneously. For information about installing and upgrading JUNOS software, see the *JUNOS System Basics Configuration Guide*.

Chapter 4

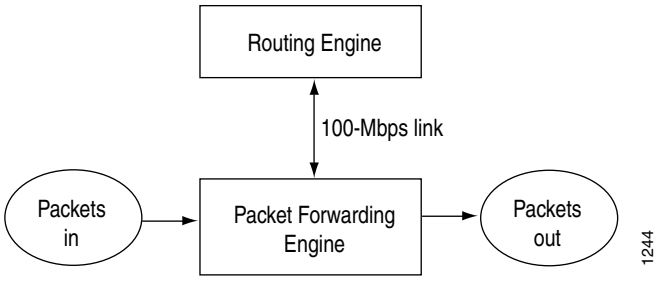
System Architecture Overview

The router module architecture consists of two major components:

- Packet forwarding engine—Performs Layer 2 and Layer 3 packet switching, route lookups, and packet forwarding.
- Routing engine—Provides Layer 3 routing services and network management.

The packet forwarding engine and the routing engine perform independently but communicate constantly through a 100-Mbps internal link. This arrangement provides streamlined forwarding and routing control and the ability to run Internet-scale networks at high speeds. Figure 4 illustrates the relationship between the packet forwarding engine and the routing engine.

Figure 4: System Architecture



For a discussion of the architectural components, see the following sections:

- Packet Forwarding Engine Architecture on page 27
- Routing Engine Architecture on page 29

Packet Forwarding Engine Architecture

The packet forwarding engine performs Layer 2 and Layer 3 packet switching. It can forward up to 8 million packets per second (Mpps) for all packet sizes, which exceeds the line speed of 4 OC12/STM4 lines. The aggregate throughput for the router module is 9.4 gigabits per second (Gbps) simplex or 4.7 Gbps full duplex. The packet forwarding engine is implemented in a single integrated

application-specific integrated circuit (ASIC). It uses a centralized route lookup engine and shared memory.

For more information, see the following sections:

- Packet Forwarding Engine Components on page 28
- Data Flow Through the Packet Forwarding Engine on page 28

Packet Forwarding Engine Components

The packet forwarding engine architecture includes the following components:

- Networking Interface—Connects the router module to a complete range of fiber-optic and digital network media. A controller ASIC in each interface performs control functions specific to the interface's media type.
- Compact Forwarding Engine Board (CFEB)—Hosts an integrated ASIC, which makes forwarding decisions, distributes data cells to the shared memory, and directs data packets when they are ready for transmission.
- Midplane—Transports packets, notifications, and other signals between the interface cards and the CFEB (as well as other system components).

Data Flow Through the Packet Forwarding Engine

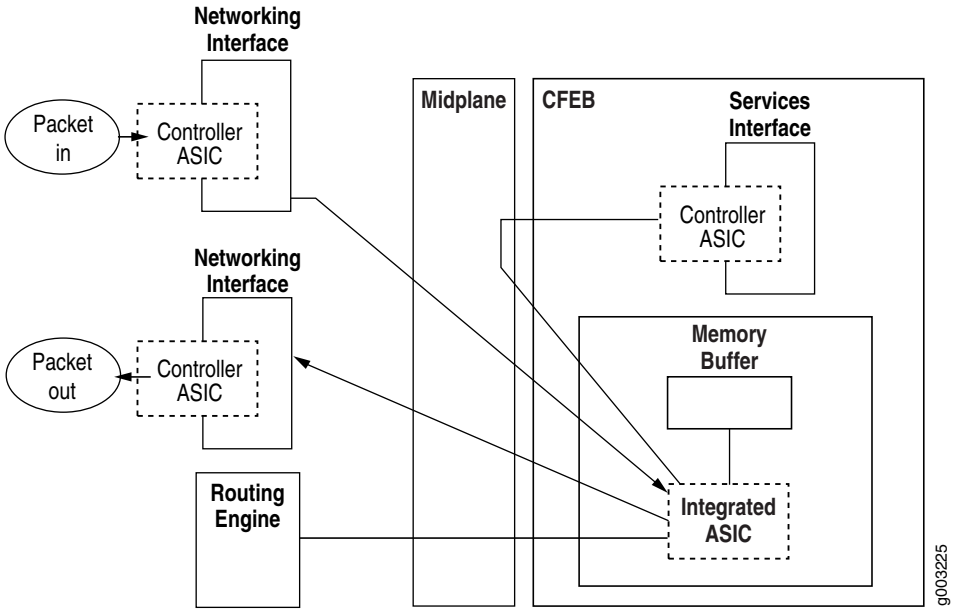
Use of ASICs promotes efficient movement of data packets through the system. Packets flow through the packet forwarding engine in the following sequence (see Figure 5):

1. Packets arrive at an incoming networking interface.
2. The networking interface passes the packets to the CFEB, where the integrated ASIC processes the packet headers, divides the packets into 64-byte data cells, and distributes the data cells throughout the memory buffer.
3. The integrated ASIC on the CFEB performs a route lookup for each packet and decides how to forward it.
    a. If services are configured for the packet, the integrated ASIC reassembles the packet and passes them to the services interface.
    b. The services interface passes the packet to the CFEB, where the integrated ASIC processes the packet, divides the packet into 64-byte cells, and distributes the data cells throughout the memory buffer.
    c. The integrated ASIC performs a second route lookup for each packet and decides how to forward it.
4. The integrated ASIC notifies the outbound networking interface.

5. The integrated ASIC reassembles data cells stored in shared memory into data packets as they are ready for transmission and passes them to the outbound networking interface.

6. The outbound networking interface transmits the data packets.

Figure 5: Packet Forwarding Engine Components and Data Flow

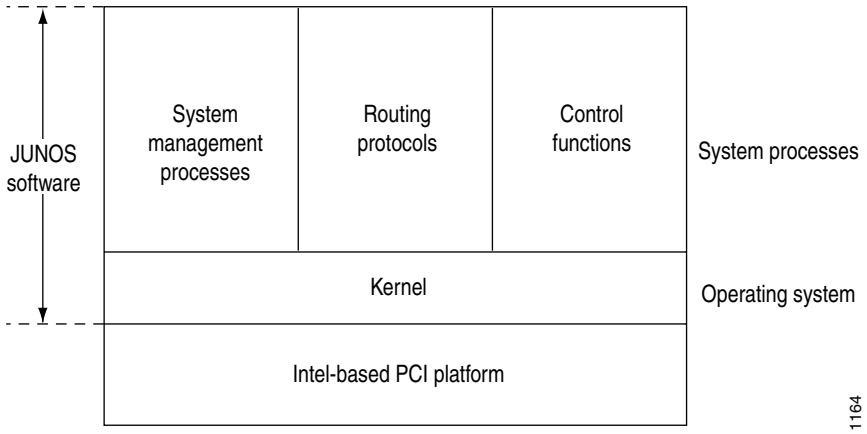


Routing Engine Architecture

The routing engine is an Intel-based PCI platform running the JUNOS Internet software, which Juniper Networks has developed and optimized to handle large numbers of network interfaces and routes. The software consists of a set of system processes running in protected memory modules on top of an independent operating system. The JUNOS kernel supports JUNOS system processes, which handle system management processes, routing protocols, and control functions (see Figure 6).

The routing engine has a dedicated 100-Mbps internal connection to the packet forwarding engine.

Figure 6: Routing Engine Architecture



Routing Engine Functions

The routing engine handles all routing protocol processes, as well as the software processes that control the router module's interfaces, the router module components, system management, and user access to the router module. These routing and software processes run on top of a kernel that interacts with the packet forwarding engine. For more information about the processes, see "Routing Engine Software Components" on page 18.

The routing engine includes the following functions and features:

- Processing of routing protocol packets—The routing engine handles all packets that concern routing protocols, freeing the packet forwarding engine to handle only packets that represent Internet traffic.
- Software modularity—Because each software process is devoted to a different function and uses a separate process space, the failure of one process has little or no effect on the others.
- In-depth Internet functionality—Each routing protocol is implemented with a complete set of Internet features and provides full flexibility for advertising, filtering, and modifying routes. Routing policies are set according to route parameters (for example, prefix, prefix lengths, and Border Gateway Protocol [BGP] attributes).
- Scalability—The JUNOS routing tables have been designed to hold all the routes in current networks with ample capacity for expansion. Additionally, the

JUNOS Internet software can efficiently support large numbers of interfaces and virtual circuits.

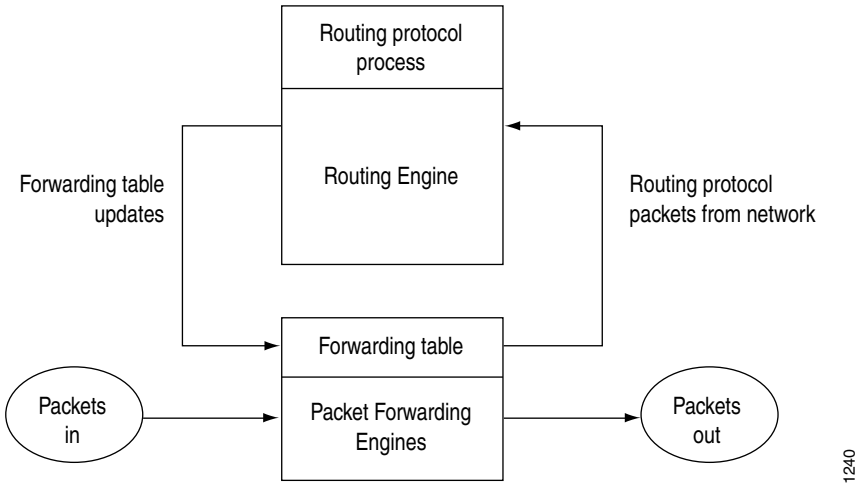
- Management interface—Different levels of system management tools are provided, including the JUNOS command-line interface (CLI), the JUNOScript application programming interface, the craft interface, and SNMP.

- Storage and change management—Configuration files, system images, and microcode can be held and maintained in primary and secondary storage systems, permitting local or remote upgrades.

- Monitoring efficiency and flexibility—The router module supports functions such as alarm handling and packet counting on every port, without degrading packet-forwarding performance.

The routing engine constructs and maintains one or more routing tables. From the routing tables, the routing engine derives a table of active routes, called the forwarding table, which is then copied into the packet forwarding engine. The design of the integrated ASIC in the CFEB allows the forwarding table in the packet forwarding engine to be updated without interrupting forwarding performance. See Figure 7.

Figure 7: Control Packet Handling: Routing and Forwarding Table Updates



Part 2

Performing Initial Installation

- Preparing to Install the Router Module on page 35
- Unpacking the Router Module on page 39
- Installing the Router Module on page 41
- Connecting Cables and Performing Initial Configuration on page 43

Chapter 5

Preparing to Install the Router Module

This chapter describes how to prepare to install an IP/MPLS router module. It discusses the following topics:

- Network Cable Specifications and Guidelines on page 35
- Cable Specifications for Routing Engine Management Ports on page 38
- Preparing the Site on page 38

Network Cable Specifications and Guidelines

The router module accepts several kinds of network cable, including multimode and single-mode fiber-optic cable. For more information, see the following sections:

- Network Cable Specifications on page 35
- Fiber-Optic Cable Guidelines on page 36

Network Cable Specifications

Table 9 lists the specifications for the types of network cable accepted by the router module.

Table 9: Network Cable Specifications

Interface Type	Cable Specification	Maximum Length	Router Module Receptacle
2-port OC12/STM4 ATM2	Duplex SC	9.3-mile/15-km reach on 9-micrometer single-mode fiber (SMF)	SC

Interface Type	Cable Specification	Maximum Length	Router Module Receptacle
2-port Gigabit Ethernet with SX SFP	Duplex LC	656-ft/200-m reach on 62.5/125-micrometer multimode fiber (MMF) 1640-ft/500-m reach on 50/125-micrometer MMF	LC
2-port Gigabit Ethernet with LX SFP	Duplex LC	6.2-mile/10-km reach on 9/125-micrometer single-mode fiber (SMF)	LC
2-port Gigabit Ethernet with LH SFP	Duplex LC	49.5-mile/70-km reach on 8.2-micrometer SMF	LC
2-port Gigabit Ethernet with 1000Base-T SFP	Four-pair, category 5 shielded twisted-pair connectivity through an RJ-45 connector	328-ft/100-m	LC

Fiber-Optic Cable Guidelines

The information in the following sections applies to multimode or single-mode fiber-optic cable.

- Multimode and Single-Mode Fiber on page 36
- Attenuation and Dispersion on page 37
- Calculating Power Budget and Margins on page 37

Multimode and Single-Mode Fiber

Multimode fiber is large enough in diameter to allow rays of light to reflect internally (bounce off the walls of the fiber). Interfaces with multimode optics typically use LEDs as light sources. LEDs are not coherent sources, however. They spray varying wavelengths of light into the multimode fiber, which reflects the light at different angles. Light rays travel in jagged lines through a multimode fiber, causing signal dispersion. When light traveling in the fiber core radiates into the fiber cladding, higher-order mode loss (HOL) results. Together these factors limit the transmission distance of multimode fiber compared to single-mode fiber.

Single-mode fiber is so small in diameter that rays of light can reflect internally through one layer only. Interfaces with single-mode optics use lasers as light sources. Lasers generate a single wavelength of light, which travels in a straight line through the single-mode fiber. Compared with multimode fiber, single-mode fiber has higher bandwidth and can carry signals for longer distances. It is consequently more expensive.

For information about the maximum transmission distances and wavelength ranges supported by multimode and single-mode (ATM) interfaces, see "OC12/STM4 ATM Ports" on page 11.

Attenuation and Dispersion

A functional optical data link depends on modulated light reaching the receiver with enough power to be correctly demodulated. *Attenuation* is the reduction in power of the light signal as it is transmitted. Attenuation is caused by passive media components, such as cables, cable splices, and connectors. While attenuation is significantly lower for optical fiber than for other media, it still occurs in both multimode and single-mode transmission. An efficient optical data link must have enough light available to overcome attenuation.

Dispersion is the spreading of the signal in time. The following two types of dispersion can affect an optical data link:

- Chromatic dispersion—The spreading of the signal in time resulting from the different speeds of light rays.
- Modal dispersion—The spreading of the signal in time resulting from the different propagation modes in the fiber.

For multimode transmission, modal dispersion, rather than chromatic dispersion or attenuation, usually limits the maximum bit rate and link length. For single-mode transmission, modal dispersion is not a factor. However, at higher bit rates and over longer distances, chromatic dispersion rather than modal dispersion limits maximum link length.

An efficient optical data link must have enough light to exceed the minimum power that the receiver requires to operate within its specifications. In addition, the total dispersion must be less than the limits specified in Telecordia GR-253-CORE Section 4.3 and ITU G.957 for the type of link.

When chromatic dispersion is at the maximum allowed, its effect can be considered as a power penalty in the power budget. The optical power budget must allow for the sum of component attenuation, power penalties (including those from dispersion), and a safety margin for unexpected losses. For more information about power budget, see "Calculating Power Budget and Margins" on page 37.

Calculating Power Budget and Margins

To ensure that fiber-optic connections have sufficient power for correct operation, you must calculate the link's power budget, which is the maximum amount

of power it can transmit. When you calculate the power budget, you use a worst-case analysis to provide a margin of error, even though all the parts of an actual system do not operate at the worst-case levels. To calculate the worst-case estimate of power budget (P_B), you assume minimum transmitter power (P_T) and minimum receiver sensitivity (P_R):

$$P_B = P_T - P_R$$

After calculating a link's power budget, you also must calculate power margin (P_M), which represents the amount of power available after subtracting attenuation or link loss (LL) from the power budget (P_B). A worst-case estimate of P_M assumes maximum LL:

$$P_M = P_B - LL$$

A P_M greater than zero indicates that the power budget is sufficient to operate the receiver.

Factors that can cause link loss include higher-order mode losses, modal and chromatic dispersion, connectors, splices and fiber attenuation.

Cable Specifications for Routing Engine Management Ports

For routing engine management and service operations, you connect the router module to an external console or management network. (For more information, see "Routing Engine Management Ports" on page 9.)

Table 10 lists the specifications for the cables that connect to management ports.

Table 10: Cable Specifications for Routing Engine Management Ports

Port	Cable Specification	Cable/Wire	Maximum Length	Router Module Receptacle
Console or auxiliary interface	RS-232 (EIA-232) serial	Cable with DB-9/DB-9 connectors	6 ft (1.83 m)	DB-9 male
Ethernet interface	Category 5 cable or equivalent suitable for 100Base-T operation	Cable with RJ-45/RJ-45 connectors	328 ft (100 m)	RJ-45 autosensing

Preparing the Site

To prepare the site, you properly install the CBX 500 switch (according to the guidelines in the *CBX 500 Multiservice WAN Switch Hardware Installation Guide* from Lucent Technologies) and acquire router module cables and connectors.

Chapter 6
Unpacking the Router Module

This chapter explains how to unpack the router module. Before beginning, prepare the installation site as described in "Preparing to Install the Router Module" on page 35 and review the safety information in "Safety and Regulatory Compliance Information" on page 75, especially "General Safety Guidelines and Warnings" on page 77. After preparing the site and reading the safety information, follow this procedure:

■ Removing the Router Module from the Carton on page 39

Removing the Router Module from the Carton

The router module is shipped in a cardboard carton, secured with foam packing material. The carton also contains the *IP/MPLS Router Module Quick Start* guide.

NOTE: The router module is maximally protected inside the shipping carton. Do not unpack it until you are ready to begin installation.

1. Move the shipping carton to a staging area as close to the installation site as possible, but where you have enough room to remove the router module.
2. Position the carton so that the arrows are pointing up.
3. Open the top flaps on the shipping carton.
4. Remove the accessory box and verify the contents against the parts inventory on the label attached to the carton.
5. Pull out the packing material holding the router module in place.
6. Save the carton and packing materials (and the shipping crate and pallet if provided) in case you must move or ship the router module later.

Chapter 7

Installing the Router Module

This chapter describes how to install the router module in the CBX 500 switch. This chapter has the following sections:

- Tools and Parts Required on page 41
- Sliding the Router Module into the CBX 500 Switch on page 41

Tools and Parts Required

To install the router module in the CBX 500 switch, you need a number 2 Phillips (+) screwdriver.

Sliding the Router Module into the CBX 500 Switch

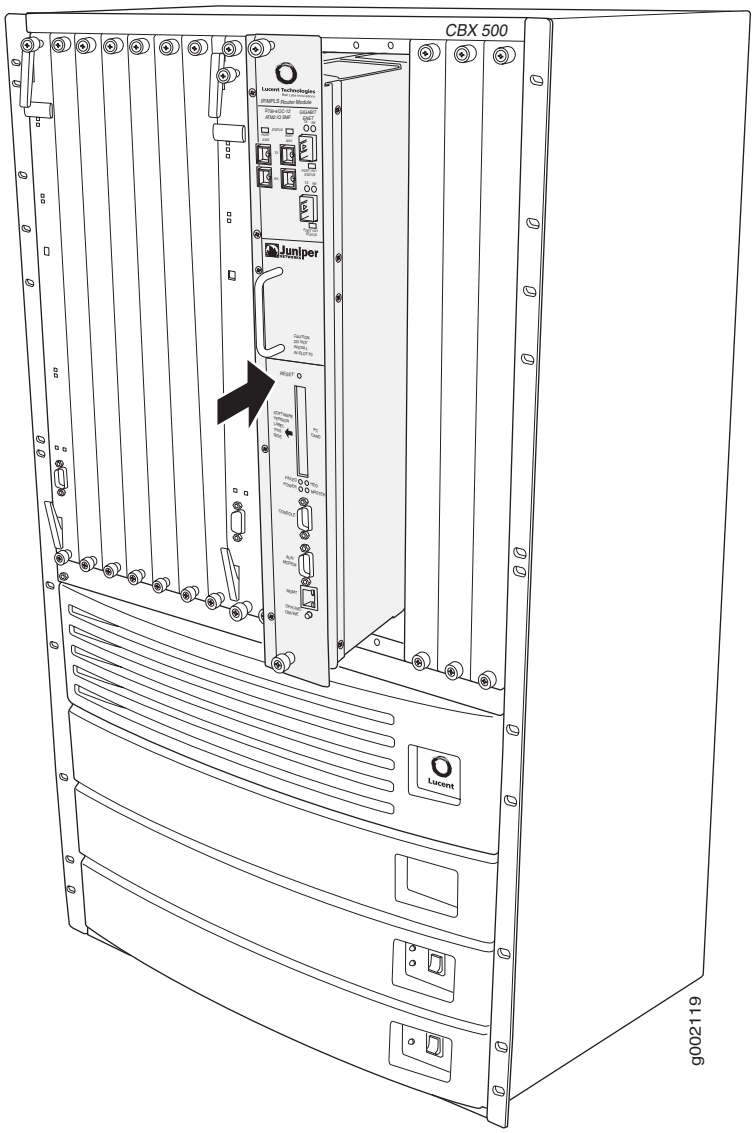
First, remove the router module from the shipping carton, as described in "Unpacking the Router Module" on page 39.

Then follow these steps to install the router module:

1. Lift the router module and slide it into any two adjacent slots except the leftmost slot (slot 3) in the CBX 500 switch, making sure the router module is vertical.

2. Use a Phillips screwdriver to tighten the two mounting screws (one in each mounting ear) at the top and bottom of the router module.

Figure 8: Installing the Router Module



3. To continue the installation, proceed to “Connecting Cables and Performing Initial Configuration” on page 43.

Chapter 8

Connecting Cables and Performing Initial Configuration

After installing the router module in the CBX 500 switch, as described in "Installing the Router Module" on page 41, complete the installation by performing the procedures described in the following sections:

- Tools and Parts Required on page 43
- Connecting the Routing Engine to Management Devices on page 43
- Installing the SFPs on page 46
- Connecting Fiber-Optic Cables on page 47
- Configuring the JUNOS Internet Software on page 48

Tools and Parts Required

To connect the routing engine to management devices and to power on the router module, you need the following tools and parts:

- Antistatic wrist strap (provided in the router module accessory kit)
- Flat-blade screwdriver, 2.5-mm

Connecting the Routing Engine to Management Devices

Connect the routing engine to one or more external devices for management and service operations. For specifications for the cable used to connect each device to the routing engine, see "Cable Specifications for Routing Engine Management Ports" on page 38.

To connect external devices, perform the procedures described in the following sections:

- Connecting the Routing Engine to a Network for Out-of-Band Management on page 44

- Connecting the Routing Engine to a Management Console or Auxiliary Device on page 45

Connecting the Routing Engine to a Network for Out-of-Band Management

To connect the routing engine to a network for out-of-band management, insert an Ethernet cable with RJ-45/RJ-45 connectors in the MGMT port on the routing engine (see "Cable Specifications for Routing Engine Management Ports" on page 38). Follow this procedure:

1. Plug one end of an Ethernet cable (Figure 9 shows the connector) in the MGMT port on the router module (Figure 10 shows the layout of the ports on the router module).
2. Plug the other end of the cable in the network device.

Figure 9: Routing Engine Ethernet Cable Connector

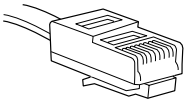
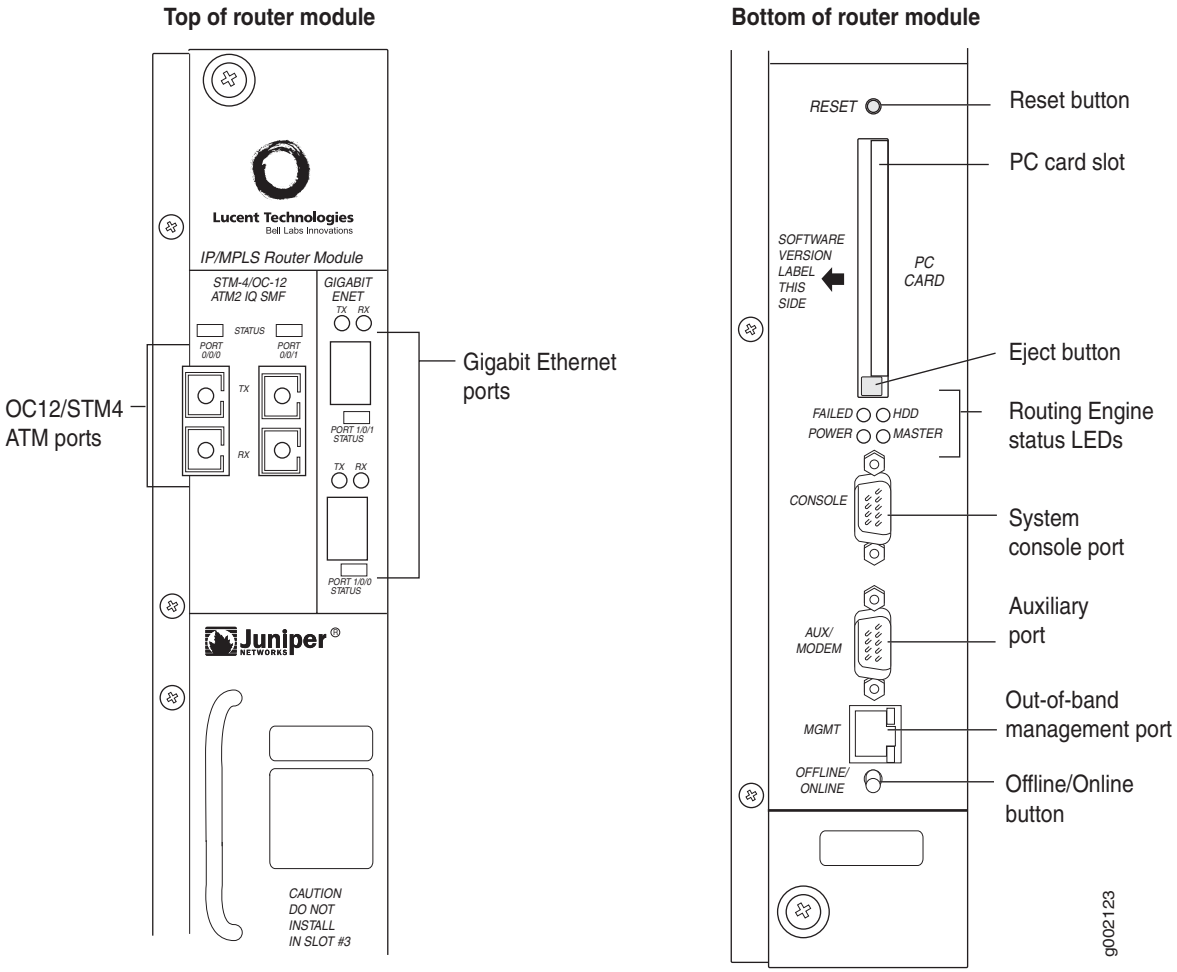


Figure 10: Router Module Ports

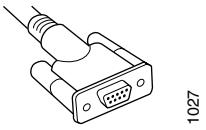


Connecting the Routing Engine to a Management Console or Auxiliary Device

To use a system console to configure and manage the routing engine, connect it to the CONSOLE port on the router module. To use a laptop, modem, or other auxiliary device, connect it to the AUX/MODEM port on the router module. Both ports accept an RS-232 (EIA-232) serial cable with DB-9/DB-9 connectors. See "Cable Specifications for Routing Engine Management Ports" on page 38. To connect a management console or auxiliary device, follow this procedure:

1. Turn off the power to the console or auxiliary device.
2. Plug the female end (shown in Figure 11) of a console cable in the CONSOLE or AUX/MODEM port. Figure 10 shows the layout of the ports on the router module.
3. Tighten the screws on the connector.

Figure 11: Console and Auxiliary Serial Port Connector

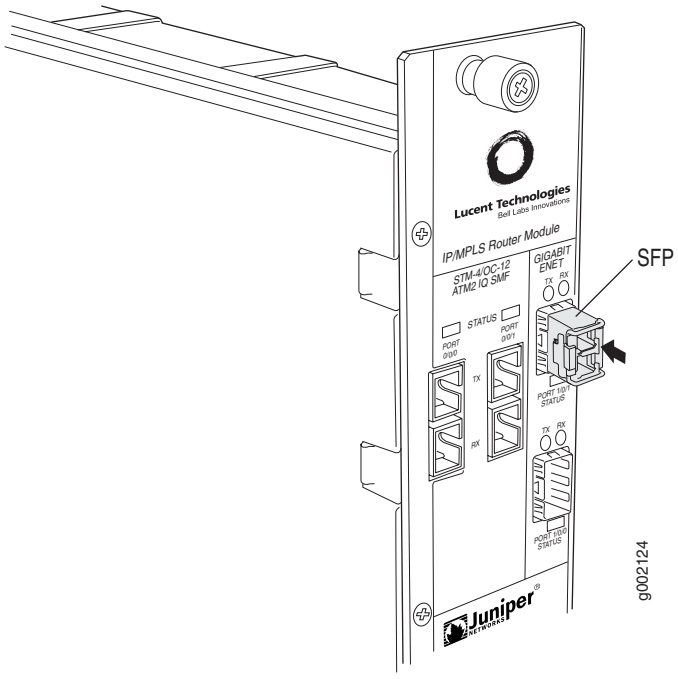


Installing the SFPs

The two SFPs are provided in the router module accessory kit. To install the SFPs, follow this procedure:

1. Put on the antistatic wrist strap that is provided in the router module accessory kit, and connect it to the grounding jack located on the front of the switch. For more information about using the wrist strap, see the *CBX 500 Multiservice WAN Switch Hardware Installation Guide* from Lucent Technologies. For more information about ESD, see "Prevent Electrostatic Discharge Damage" on page 80.
2. Verify that a rubber safety cap covers each SFP transceiver, installing them if necessary.
3. Orient each SFP over the port in the router module so that the connector end will enter the slot first and the SFP connector faces to the left.

Figure 12: Installing an SFP in a Gigabit Ethernet Slot



4. Slide each SFP into its slot. If there is resistance, remove the SFP and flip it so that the connector faces the other direction.

WARNING: Do not look directly into installed SFPs, into the transceivers on the router module's faceplate, or into the ends of fiber-optic cables. Single-mode fiber-optic cable and the interfaces that use it (such as ATM interfaces) emit laser light that can damage your eyes.

CAUTION: Do not leave a fiber-optic transceiver uncovered except when inserting or removing a cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

Connecting Fiber-Optic Cables

To connect fiber-optic network cables to the ports on the router module's faceplate or to the ports of the SFPs, follow this procedure for each port:

1. Make sure you have the correct length and type of cable, as specified in "Network Cable Specifications" on page 35.

2. If the port is covered by a rubber safety cap, remove the cap.

WARNING: Do not look directly into installed SFPs, into the transceivers on the router module's faceplate, or into the ends of fiber-optic cables. Single-mode fiber-optic cable and the interfaces that use it (such as ATM interfaces) emit laser light that can damage your eyes.

CAUTION: Do not leave a fiber-optic transceiver uncovered except when inserting or removing a cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

3. Insert the cable connector into the port on the faceplate or on the SFP.

4. Arrange the cable to prevent it from dislodging or developing stress points. Secure the cable so that it does not support its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop. Placing fasteners on the loop helps to maintain its shape.

CAUTION: Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

CAUTION: Do not let fiber-optic cable hang free from the connector. Do not allow fastened loops of cable to dangle, which stresses the cable at the fastening point.

5. Verify that the port is functioning correctly by noting whether the port's STATUS LED is green.

   An LED marked PORT 0/0/0 STATUS or PORT 0/0/1 STATUS next to each OC12/STM4 ATM port indicates its status:

   - Off indicates that the port is not enabled
   - Green indicates that the port is online with no alarms or failures
   - Amber indicates that the port is online with alarms for remote failures
   - Red indicates that the port is active with a local alarm (the router module has detected a failure)

   An LED marked PORT 1/0/0 STATUS or PORT 1/0/1 STATUS next to each Gigabit Ethernet port indicates its status:

   - Green indicates that the port is operating normally
   - Red indicates an error or failure
   - Off indicates that the port is not enabled

   You can also verify correct port function by issuing the show chassis fpc pic-status command.

Configuring the JUNOS Internet Software

The router module is shipped with the JUNOS Internet software preinstalled and ready to be configured when the router module is powered on.

There are three copies of the software: one on a nonrotating flash drive in the router module, one on a rotating hard drive in the router module, and one on a PC card that can be inserted in the slot in the router module faceplate.

When the router module boots, it first attempts to start the image on the PC card. If a PC card is not inserted in the router module or the attempt otherwise fails, the router module next tries the flash drive, and finally the hard drive.

You configure the router module by issuing JUNOS command-line interface (CLI) commands, either on a console device attached to the CONSOLE port on the router module, or over a telnet connection to a network connected to the MGMT port on the router module. Gather the following information before configuring the router module:

- Name the router module will use on the network
- Domain name the router module will use
- IP address and prefix length information for the Ethernet interface
- IP address of a backup router
- IP address of a DNS server
- Password for the root user

To configure the software, follow this procedure:

1. Make sure that the switch is powered on.
2. Log in as the "root" user. There is no password.
3. Start the CLI.

   ```
   root# cli
   root@>
   ```

4. Enter configuration mode.

   ```
   cli> configure
   [edit]
   root@#
   ```

5. Configure the name of the router module. If the name includes spaces, enclose the name in quotation marks (" ").

   ```
   [edit]
   root@# set system host-name host-name
   ```

6. Configure the router module's domain name.

   ```
   [edit]
   root@# set system domain-name domain-name
   ```

7. Configure the IP address and prefix length for the router module's Ethernet interface.

   ```
   [edit]
   root@# set interfaces fxp0 unit 0 family inet address address/prefix-length
   ```

8. Configure the IP address of a backup router, which is used only while the routing protocol is not running.

```
[edit]
root@# set system backup-router address
```

9. Configure the IP address of a DNS server.

```
[edit]
root@# set system name-server address
```

10. Set the root authentication password by entering a clear-text password, an encrypted password, or an SSH public key string (DSA or RSA).

```
[edit]
root@# set system root-authentication plain-text-password
New password: password
Retype new password: password
```

or

```
[edit]
root@# set system root-authentication encrypted-password encrypted-password
```

or

```
[edit]
root@# set system root-authentication ssh-dsa public-key
```

or

```
[edit]
root@# set system root-authentication ssh-rsa public-key
```

11. Optionally, display the configuration to verify that it is correct.

```
[edit]
root@# show
system {
            host-name host-name;
            domain-name domain-name;
            backup-router address;
   root-authentication {
               authentication-method (password | public-key);
   }
   name-server {
               address;
   }
}
interfaces {
   fxp0 {
      unit 0 {
         family inet {
                  address address/prefix-length;
         }
      }
```

```
    }
}
```

12. Commit the configuration to activate it on the router module.

    ```
    [edit]
    root@# commit
    ```

13. Optionally, configure additional properties by adding the necessary configuration statements. Then commit the changes to activate them on the router module.

    ```
    [edit]
    root@hostname# commit
    ```

14. When you have finished configuring the router module, exit configuration mode.

    ```
    [edit]
    root@hostname# exit
    root@hostname>
    ```

The commands in Steps 5 through 12 connect the router module to the network but do not enable it to forward traffic. For complete information about the commands to issue in Step 13, including examples, see the JUNOS Internet software configuration guides.

For information about using NavisCore or Navis EMS-CBGX network management software with the router module, see the documentation from Lucent Technologies.

Part 3

Maintaining Hardware, Replacing Parts, and Troubleshooting

- Maintaining Hardware Components on page 55
- Replacing Hardware Components on page 57
- Troubleshooting Hardware Components on page 69

Chapter 9

Maintaining Hardware Components

This chapter describes how to maintain the router module and SFPs.

For information about returning the router module to Juniper Networks for repair or replacement, see “Returning the Router Module” on page 89.

- Performing Routine Maintenance on page 55
- Maintaining the Router Module on page 55

Performing Routine Maintenance

For optimum router module performance, inspect the installation site regularly for potential problems caused by moisture, loose wires or cables, and excessive dust.

Maintaining the Router Module

To maintain the router module, perform the following procedures on a regular basis:

- Check the LEDs on the router module. The green LED labeled POWER lights steadily when it is functioning normally. For more information about the LEDs, see “Routing Engine” on page 8.

- Issue the CLI show chassis routing-engine command to check the status of the router module:

```
user@host> show chassis routing-engine

Routing Engine status:
    Temperature                 25 degrees C / 77 degrees F
    CPU temperature             26 degrees C / 78 degrees F
    DRAM                       768 MB
    Memory utilization          20 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
      Kernel                     3 percent
      Interrupt                  0 percent
      Idle                      97 percent
    Model                          RE-5.0
    Serial ID                      1000513663
    Start time                     2004-07-16 10:26:10 PDT
```

```
Uptime                       3 days, 7 hours, 30 minutes, 21 seconds
Load averages:                1 minute   5 minute  15 minute
                                  0.06       0.02       0.00
```

For further description of the output from the command, see the *JUNOS Protocols, Class of Service, and System Basics Command Reference*.

Chapter 10
Replacing Hardware Components

You can remove and replace only cables and the two SFPs yourself. When you must replace one of these components, contact your customer support or sales representative to order the component. For instructions, see "Returning the Router Module" on page 89.

- Tools and Parts Required on page 57
- Replacing Fiber-Optic Cables on page 57
- Replacing an SFP on page 60
- Replacing Router Module Components on page 63

Tools and Parts Required

To replace hardware components, you need the following tools and parts:

- Antistatic wrist strap (for the router module)
- Phillips (+) screwdriver, number 2 (for the router module)
- Flat-blade screwdriver, 2.5-mm (for the console port cable)
- Rubber safety caps (for the fiber-optic cables)

Replacing Fiber-Optic Cables

Removing and installing fiber-optic cables does not affect router module function, except that the module does not receive or transmit data while its cable is disconnected. To replace a fiber-optic cable, perform the following procedures:

- Removing a Fiber-Optic Cable on page 57
- Installing a Fiber-Optic Cable on page 58

Removing a Fiber-Optic Cable

To remove a fiber-optic cable, follow this procedure:

1. Have ready a rubber safety cap for each cable you are removing.
2. Unplug the cable from the port and immediately cover each transceiver and the end of each cable with a rubber safety cap.

WARNING: Do not look directly into installed SFPs, into the transceivers on the router module's faceplate, or into the ends of fiber-optic cables. Single-mode fiber-optic cable and the interfaces that use it (such as ATM interfaces) emit laser light that can damage your eyes.

CAUTION: Do not leave a fiber-optic transceiver uncovered except when inserting or removing a cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

3. Arrange the cable to prevent it from dislodging or developing stress points. Secure the cable so that it does not support its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop. Placing fasteners on the loop helps to maintain its shape.

CAUTION: Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

Installing a Fiber-Optic Cable

To install a fiber-optic cable, follow this procedure:

1. Have ready a length of the type of cable used by the interface, as specified in "Network Cable Specifications" on page 35.
2. If the interface port is covered by a rubber safety cap, remove the cap.

WARNING: Do not look directly into installed SFPs, into the transceivers on the router module's faceplate, or into the ends of fiber-optic cables. Single-mode fiber-optic cable and the interfaces that use it (such as ATM interfaces) emit laser light that can damage your eyes.

CAUTION: Do not leave a fiber-optic transceiver uncovered except when inserting or removing a cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

3. Insert the cable connector in the port on the router module's faceplate.

4. Arrange the cable to prevent it from dislodging or developing stress points. Secure the cable so that it does not support its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop. Placing fasteners on the loop helps to maintain its shape.

CAUTION: Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

CAUTION: Do not let fiber-optic cable hang free from the connector. Do not allow fastened loops of cable to dangle, which stresses the cable at the fastening point.

5. Verify that the port is functioning correctly by noting whether the port's STATUS LED is green.

   An LED marked PORT 0/0/0 STATUS or PORT 0/0/1 STATUS next to each OC12/STM4 ATM port indicates its status:

   - Off indicates that the port is not enabled
   - Green indicates that the port is online with no alarms or failures
   - Amber indicates that the port is online with alarms for remote failures
   - Red indicates that the port is active with a local alarm (the router module has detected a failure)

   An LED marked PORT 1/0/0 STATUS or PORT 1/0/1 STATUS next to each Gigabit Ethernet port indicates its status:

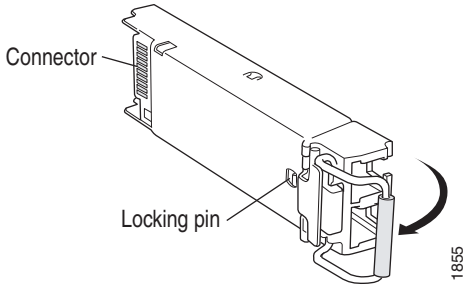
   - Green indicates that the port is operating normally
   - Red indicates an error or failure
   - Off indicates that the port is not enabled

You can also verify correct port function by issuing the show chassis fpc pic-status command.

Replacing an SFP

SFPs are hot-insertable and hot-removable. Removing an SFP does not interrupt router module functioning, but the removed SFP no longer receives or transmits data.

Figure 13: Small Form-Factor Pluggable (SFP)



To replace an SFP, perform the following procedures:

- Removing an SFP on page 60
- Installing an SFP on page 61

Removing an SFP

To remove an SFP, follow this procedure (see Figure 14):

1. Place an electrostatic bag or antistatic mat on a flat, stable surface to receive the SFP. Have ready a rubber safety cap for the SFP transceiver and the cable.
2. Put on the antistatic wrist strap that is provided in the router module accessory kit, and connect it to the grounding jack located on the front of the switch. For more information about using the wrist strap, see the *CBX 500 Multiservice WAN Switch Hardware Installation Guide* from Lucent Technologies. For more information about ESD, see “Prevent Electrostatic Discharge Damage” on page 80.
3. Label the cable connected to the SFP so that you can later reconnect it to the correct SFP.
4. Disconnect the cable from the SFP. Immediately cover the transceiver and the end of the cable with a rubber safety cap.

WARNING: Do not look directly into installed SFPs, into the transceivers on the router module's faceplate, or into the ends of fiber-optic cables. Single-mode fiber-optic cable and the interfaces that use it (such as ATM interfaces) emit laser light that can damage your eyes.

CAUTION: Do not leave a fiber-optic transceiver uncovered except when inserting or removing a cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

5. Arrange the cable to prevent it from dislodging or developing stress points. Secure the cable so that it does not support its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop. Placing fasteners on the loop helps to maintain its shape.

CAUTION: Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

6. Pull the ejector handle away from the SFP faceplate to unseat the SFP from the router module. Pull the SFP out of the router module and place it on the antistatic mat or in the electrostatic bag.

Installing an SFP

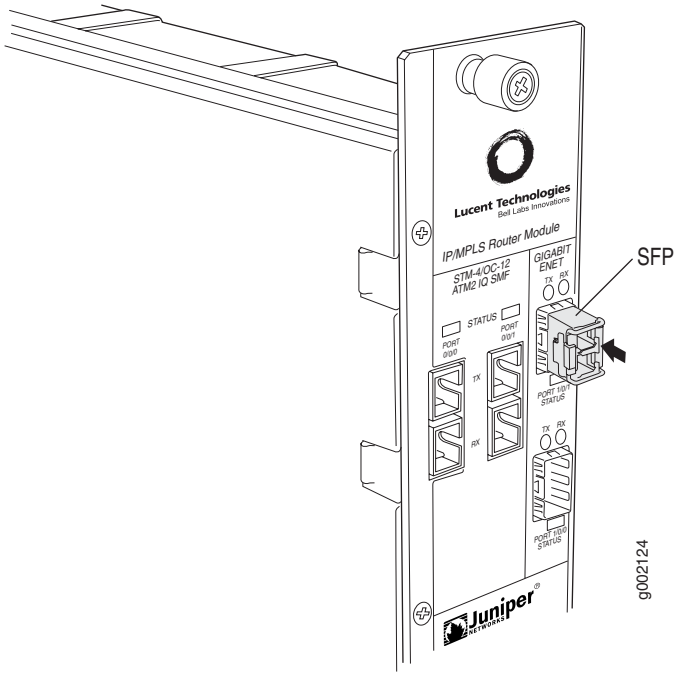
To install a replacement SFP, follow this procedure (see Figure 14):

1. Put on the antistatic wrist strap that is provided in the router module accessory kit, and connect it to the grounding jack located on the front of the switch. For more information about using the wrist strap, see the *CBX 500 Multiservice WAN Switch Hardware Installation Guide* from Lucent Technologies. For more information about ESD, see "Prevent Electrostatic Discharge Damage" on page 80.

2. Verify that a rubber safety cap covers the SFP transceiver, installing one if necessary.

3. Orient the SFP over the port in the router module so that the connector end will enter the slot first and the SFP connector faces to the left.

Figure 14: Installing a Replacement SFP in a Gigabit Ethernet Slot



4. Slide the SFP into the slot. If there is resistance, remove the SFP and flip it so that the connector faces the other direction.

5. Remove the rubber safety cap from the transceiver and the end of the cable, and insert the cable into the transceiver.

WARNING: Do not look directly into installed SFPs, into the transceivers on the router module's faceplate, or into the ends of fiber-optic cables. Single-mode fiber-optic cable and the interfaces that use it (such as ATM interfaces) emit laser light that can damage your eyes.

CAUTION: Do not leave a fiber-optic transceiver uncovered except when inserting or removing a cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

6. Arrange the cable to prevent the cable from dislodging or developing stress points. Secure the cable so that it does not support its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop. Placing fasteners on the loop helps to maintain its shape.

CAUTION: Do not let fiber-optic cable hang free from the connector. Do not allow fastened loops of cable to dangle, which stresses the cable at the fastening point.

CAUTION: Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

7. Verify that theSTATUS LED on the faceplate indicates that the SFP is functioning correctly (there is an LED for each SFP port). The STATUS LED is green if the port is operating normally. (Red indicates an error or failure, and off indicates that the port is not enabled.) You can also verify SFP functioning by issuing the show chassis fpc pic-status command.

Replacing Router Module Components

For instructions on replacing router module components, see the following sections:

- Replacing the Interface Port Cables on page 63
- Removing and Inserting a PC Card on page 65

Replacing the Interface Port Cables

The interface ports, which accept connections to external management devices, are on the front of the router module, as shown in Figure 1.

To replace the cables connecting to the interface ports, perform the following procedures:

- Replacing the Management Ethernet Cable on page 63
- Replacing the Console or Auxiliary Cable on page 64

Replacing the Management Ethernet Cable

To replace the management Ethernet cable, follow this procedure:

1. Press the tab on the connector on the management Ethernet cable and pull the connector straight out of the port. Figure 15 shows the connector.
2. Disconnect the cable from the network device.

3. Plug one end of the replacement Ethernet cable in the MGMT port (see Figure 16).
4. Plug the other end of the cable in the network device.

Figure 15: Routing Engine Ethernet Cable Connector

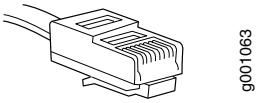
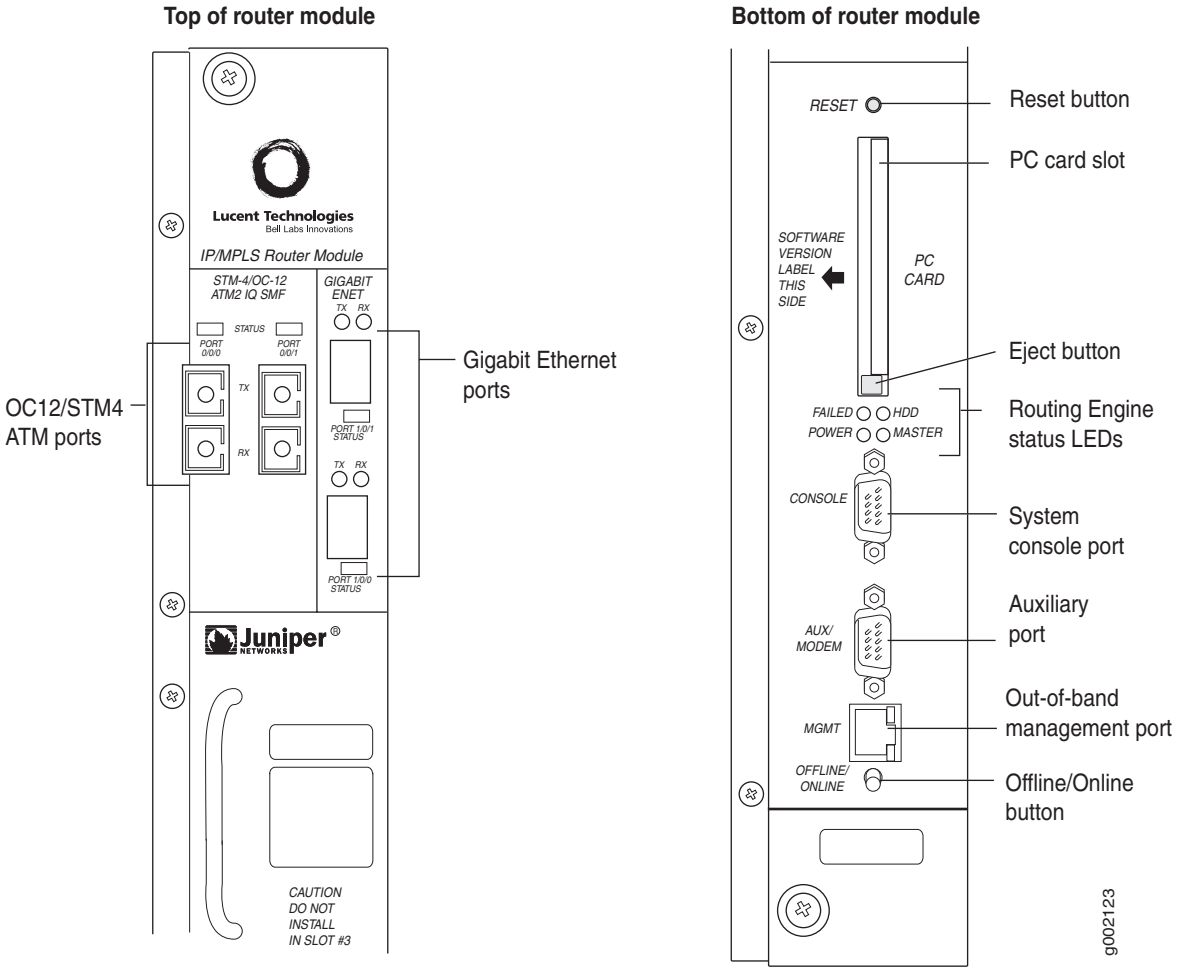


Figure 16: Router Module Ports



Replacing the Console or Auxiliary Cable

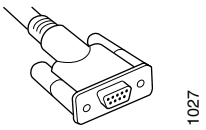
To remove the cable from the CONSOLE or AUX/MODEM port, follow these steps:

1. Turn off the power to the console or auxiliary device.
2. Unscrew the screws that secure the cable connector to the port, using a 2.5-mm flat-blade screwdriver if necessary.
3. Pull the cable connector straight out of the port.
4. Disconnect the cable from the console or auxiliary device.

To connect the new cable, follow these steps:

1. Plug the female end of the replacement serial cable in the CONSOLE or AUX/MODEM port (see Figure 16).
2. Tighten the screws on the connector.
3. Power on the auxiliary or console device.

Figure 17: Console and Auxiliary Serial Port Connector



Removing and Inserting a PC Card

The slot labeled PC CARD on the router module faceplate accepts a Type I PC card, as defined in the *PC Card Standard* published by the Personal Computer Memory Card International Association (PCMCIA). You can also copy JUNOS software from the router module onto a PC card, for example, to create a backup copy of upgrade software that you have obtained from Juniper Networks.

To remove and insert a PC card, perform the following procedures:

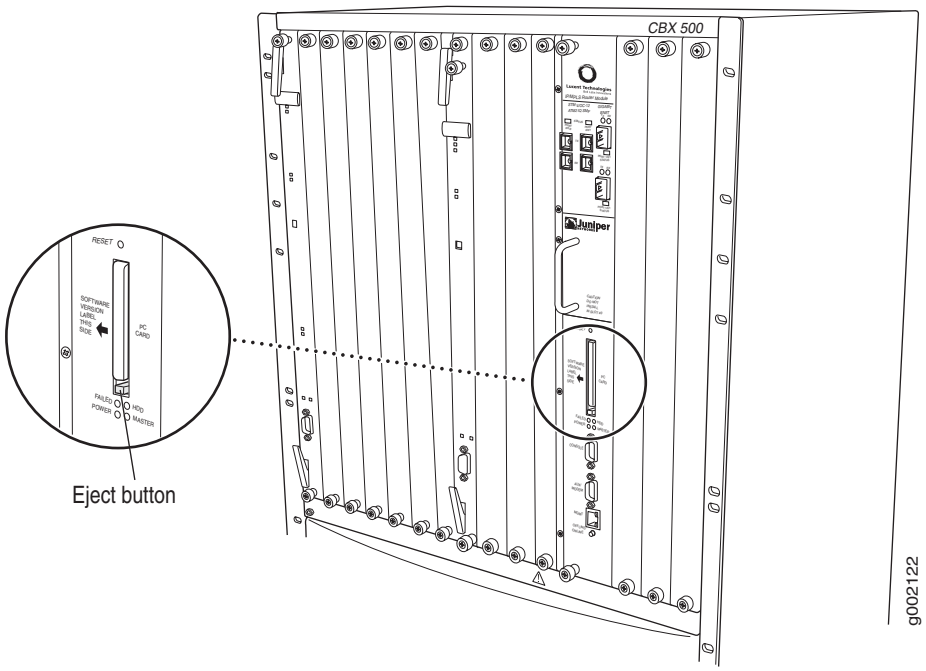
- Removing the PC Card on page 65
- Replacing the PC Card Adapter Flash Disk on page 66
- Inserting the PC Card on page 67

Removing the PC Card

A PC card is inserted in the slot labeled PC CARD in the faceplate. To remove the PC card, follow this procedure (see Figure 18):

1. Press the eject button located at the bottom of the PC card slot.
2. When the PC card pops partially out of the slot, grasp the card and pull it straight out of the slot.

Figure 18: Removing the PC Card

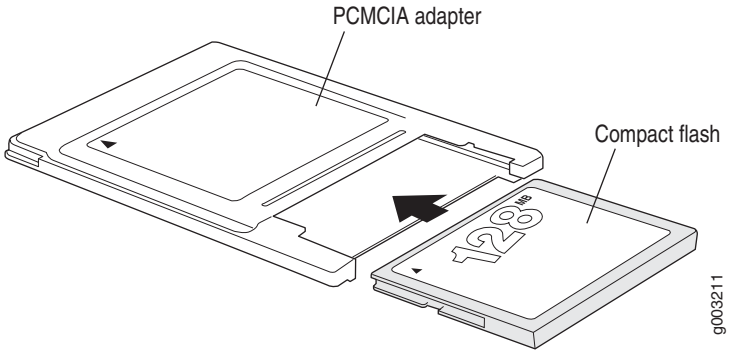


Replacing the PC Card Adapter Flash Disk

A PC card is an adapter that holds a flash disk. To replace the flash disk, follow this procedure (see Figure 19):

1. If a flash disk is already inserted in the PC card adapter, slide the flash disk out of the adapter.
2. Align the replacement flash disk with the adapter.
3. Press the flash disk firmly all the way into the adapter.

Figure 19: Inserting the PC Card Flash Disk

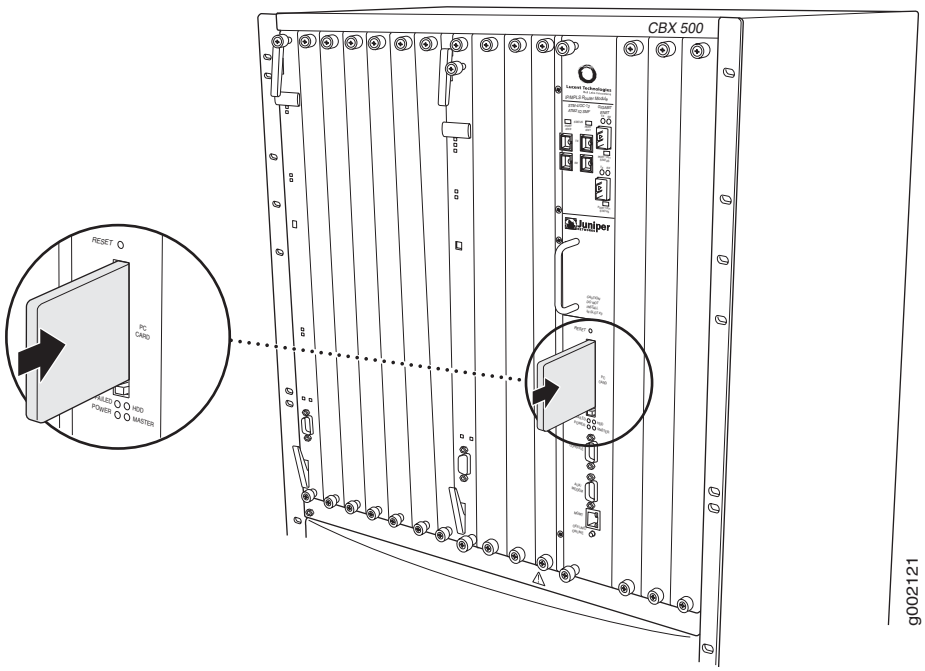


Inserting the PC Card

To insert the PC card, follow this procedure (see Figure 20):

1. Orient the PC card with the Juniper Networks logo facing in the direction specified on the faceplate. Insert the card into the slot.
2. Press the card firmly all the way into the slot.

Figure 20: Inserting the PC Card



Chapter 11

Troubleshooting Hardware Components

This chapter describes how to troubleshoot problems with hardware components. If you encounter software problems, or problems with hardware components not discussed here, contact the Lucent Technical Assistance Center as described in "Getting Help from the Lucent Technical Assistance Center" on page 71. To troubleshoot hardware components, follow this procedure:

- Overview of Troubleshooting Resources on page 69

Overview of Troubleshooting Resources

This section provides an overview of the resources you can use while troubleshooting problems with the router module:

- Using the Command-Line Interface on page 69
- LEDs on page 70
- Hardware Alarm Messages on page 70
- Getting Help from the Lucent Technical Assistance Center on page 71

Using the Command-Line Interface

The JUNOS Internet software command-line interface (CLI) is the primary tool for controlling and troubleshooting router module hardware, the JUNOS Internet software, routing protocols, and network connectivity. CLI commands display information from routing tables, information specific to routing protocols, and information about network connectivity derived from the ping and traceroute utilities.

You enter CLI commands on one or more external management devices connected to the router module. There is a port labeled AUX/MODEM for attaching a laptop, modem, or other auxiliary device, a port labeled CONSOLE for attaching a system console, and an Ethernet port labeled MGMT for attaching to a management LAN. For more information, see "Routing Engine Management Ports" on page 9.

For information about using the CLI to display details about alarms generated by interfaces and hardware components, see "Hardware Alarm Messages" on page 70.

For information about using the CLI to troubleshoot the JUNOS Internet software, see the appropriate JUNOS Internet software configuration guide.

LEDs

A set of four LEDs on the bottom half of the faceplate indicate the routing engine status:

Table 11: States for Routing Engine LEDs

Label	Color	State	Description
HDD	Green	Blinking	There is read/write activity on the PC card.
MASTER	Blue	On steadily	Routing engine is functioning as master. On an IP/MPLS router module, this LED is always lit.
FAILED	Red	On steadily	Routing engine is not operational.
POWER	Green	On steadily	Routing engine is running normally.

An LED marked PORT 0/0/0 STATUS or PORT 0/0/1 STATUS next to each OC12/STM4 ATM port indicates its status:

- Off indicates that the port is not enabled
- Green indicates that the port is online with no alarms or failures
- Amber indicates that the port is online with alarms for remote failures
- Red indicates that the port is active with a local alarm (the router module has detected a failure)

An LED marked PORT 1/0/0 STATUS or PORT 1/0/1 STATUS next to each Gigabit Ethernet port indicates its status:

- Green indicates that the port is operating normally
- Red indicates an error or failure
- Off indicates that the port is not enabled

Hardware Alarm Messages

You can issue the show chassis alarms CLI command to view hardware and interface alarm messages.

There are two classes of alarm messages:

- Chassis alarms—Indicate a problem with a chassis component such as the cooling system or power supplies.
- Interface alarms—Indicate a problem with a specific network interface.

Getting Help from the Lucent Technical Assistance Center

The Lucent Technical Assistance Center (TAC) is available to assist you with any problems encountered while you use this Lucent product. Log on to the Customer Support Web site to obtain telephone numbers for the Lucent TAC in your region:

http://www.lucent.com/support

Part 4

Appendixes

- Safety and Regulatory Compliance Information on page 75
- Returning the Router Module on page 89
- Cable Connector Pinouts on page 93

Appendix A

Safety and Regulatory Compliance Information

To install and use the router module safely, follow proper safety procedures. This chapter provides the following safety and regulatory compliance information:

- Definition of Safety Warning Levels on page 75
- Safety Guidelines and Warnings on page 76
- Agency Approvals on page 87
- Compliance Statements for EMC Requirements on page 87

Definition of Safety Warning Levels

This manual uses the following three levels of safety warnings:

NOTE: You might find this information helpful in a particular situation, or might otherwise overlook it.

CAUTION: You must observe the specified guidelines to avoid minor injury or discomfort to you, or severe damage to the router module.

WARNING: This symbol means danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents.

Waarschuwing Dit waarschuwingssymbool betekent gevaar. U verkeert in een situatie die lichamelijk letsel kan veroorzaken. Voordat u aan enige apparatuur gaat werken, dient u zich bewust te zijn van de bij elektrische schakelingen betrokken risico's en dient u op de hoogte te zijn van standaard maatregelen om ongelukken te voorkomen.

Varoitus Tämä varoitusmerkki merkitsee vaaraa. Olet tilanteessa, joka voi johtaa ruumiinvammaan. Ennen kuin työskentelet minkään laitteiston parissa, ota selvää sähkökytkentöihin liittyvistä vaaroista ja tavanomaisista onnettomuuksien ehkäisykeinoista.

Attention Ce symbole d'avertissement indique un danger. Vous vous trouvez dans une situation pouvant causer des blessures ou des dommages corporels. Avant de travailler sur un équipement, soyez conscient des dangers posés par les circuits électriques et familiarisez-vous avec les procédures couramment utilisées pour éviter les accidents.

Warnung Dieses Warnsymbol bedeutet Gefahr. Sie befinden sich in einer Situation, die zu einer Körperverletzung führen könnte. Bevor Sie mit der Arbeit an irgendeinem Gerät beginnen, seien Sie sich der mit elektrischen Stromkreisen verbundenen Gefahren und der Standardpraktiken zur Vermeidung von Unfällen bewußt.

Avvertenza Questo simbolo di avvertenza indica un pericolo. La situazione potrebbe causare infortuni alle persone. Prima di lavorare su qualsiasi apparecchiatura, occorre conoscere i pericoli relativi ai circuiti elettrici ed essere al corrente delle pratiche standard per la prevenzione di incidenti.

Advarsel Dette varselsymbolet betyr fare. Du befinner deg i en situasjon som kan føre til personskade. Før du utfører arbeid på utstyr, må du vare oppmerksom på de faremomentene som elektriske kretser innebærer, samt gjøre deg kjent med vanlig praksis når det gjelder å unngå ulykker.

Aviso Este símbolo de aviso indica perigo. Encontra-se numa situação que lhe poderá causar danos físicos. Antes de começar a trabalhar com qualquer equipamento, familiarize-se com os perigos relacionados com circuitos eléctricos, e com quaisquer práticas comuns que possam prevenir possíveis acidentes.

¡Atención! Este símbolo de aviso significa peligro. Existe riesgo para su integridad física. Antes de manipular cualquier equipo, considerar los riesgos que entraña la corriente eléctrica y familiarizarse con los procedimientos estándar de prevención de accidentes.

Varning! Denna varningssymbol signalerar fara. Du befinner dig i en situation som kan leda till personskada. Innan du utför arbete på någon utrustning måste du vara medveten om farorna med elkretsar och känna till vanligt förfarande för att förebygga skador.

Safety Guidelines and Warnings

This section provides the safety guidelines and warnings for installing, operating, and maintaining the router module:

■ General Safety Guidelines and Warnings on page 77

- Electrical Safety Guidelines and Warnings on page 81
- Laser and LED Safety Guidelines and Warnings on page 81
- Maintenance and Operational Safety Guidelines and Warnings on page 85

General Safety Guidelines and Warnings

The following guidelines help ensure your safety and protect the router module from damage. The list of guidelines might not address all potentially hazardous situations in your working environment, so be alert and exercise good judgement at all times.

- Perform only the procedures explicitly described in this manual. Make sure that only authorized service personnel perform other system services.
- Keep the area around the router module clear and free from dust before, during, and after installation.
- Keep tools away from areas where people could trip over them while walking.
- Do not wear loose clothing or jewelry, such as rings, bracelets, or chains, which could become caught in the router module.
- Wear safety glasses if you are working under any conditions that could be hazardous to your eyes.
- Do not perform any actions that create a potential hazard to people or make the equipment unsafe.
- Never attempt to lift an object that is too heavy for one person to handle.
- Never install or manipulate wiring during electrical storms.
- Never install electrical jacks in wet locations unless the jacks are specifically designed for wet environments.
- Operate the router module only when it is properly grounded.
- Replace fuses only with fuses of the same type and rating.
- Do not open or remove router module covers or sheet metal parts when instructions are not provided in this manual. Such an action could cause severe electrical shock.
- Do not push or force any objects through any opening in the router module frame. Such an action could result in electrical shock or fire.
- Avoid spilling liquid onto the router module or onto any router module component. Such an action could cause electrical shock or damage the router module.

- Avoid touching uninsulated electrical wires or terminals that have not been disconnected from their power source. Such an action could cause electrical shock.
- Observe the following warnings and guidelines:
  - "Qualified Personnel Warning" on page 78
  - "Restricted Access Area Warning " on page 79
  - "Prevent Electrostatic Discharge Damage" on page 80

Qualified Personnel Warning

WARNING: Only trained and qualified personnel should install or replace the router module.

Waarschuwing Installatie en reparaties mogen uitsluitend door getraind en bevoegd personeel uitgevoerd worden.

Varoitus Ainoastaan koulutettu ja pätevä henkilökunta saa asentaa tai vaihtaa tämän laitteen.

Avertissement Tout installation ou remplacement de l'appareil doit être réalisé par du personnel qualifié et compétent.

Achtung Gerät nur von geschultem, qualifiziertem Personal installieren oder auswechseln lassen.

Avvertenza Solo personale addestrato e qualificato deve essere autorizzato ad installare o sostituire questo apparecchio.

Advarsel Kun kvalifisert personell med riktig opplæring bør montere eller bytte ut dette utstyret.

Aviso Este equipamento deverá ser instalado ou substituído apenas por pessoal devidamente treinado e qualificado.

¡Atención! Estos equipos deben ser instalados y reemplazados exclusivamente por personal técnico adecuadamente preparado y capacitado.

Varning Denna utrustning ska endast installeras och bytas ut av utbildad och kvalificerad personal.

Restricted Access Area Warning

WARNING: The router module is intended for installation in restricted access areas. A restricted access area is an area to which access can be gained only by service personnel through the use of a special tool, lock and key, or other means of security, and which is controlled by the authority responsible for the location.

Waarschuwing Dit toestel is bedoeld voor installatie op plaatsen met beperkte toegang. Een plaats met beperkte toegang is een plaats waar toegang slechts door servicepersoneel verkregen kan worden door middel van een speciaal instrument, een slot en sleutel, of een ander veiligheidsmiddel, en welke beheerd wordt door de overheidsinstantie die verantwoordelijk is voor de locatie.

Varoitus Tämä laite on tarkoitettu asennettavaksi paikkaan, johon pääsy on rajoitettua. Paikka, johon pääsy on rajoitettua, tarkoittaa paikkaa, johon vain huoltohenkilöstö pääsee jonkin erikoistyökalun, lukkoon sopivan avaimen tai jonkin muun turvalaitteen avulla ja joka on paikasta vastuussa olevien toimivaltaisten henkilöiden valvoma.

Attention Cet appareil est à installer dans des zones d'accès réservé. Ces dernières sont des zones auxquelles seul le personnel de service peut accéder en utilisant un outil spécial, un mécanisme de verrouillage et une clé, ou tout autre moyen de sécurité. L'accès aux zones de sécurité est sous le contrôle de l'autorité responsable de l'emplacement.

Warnung Diese Einheit ist zur Installation in Bereichen mit beschränktem Zutritt vorgesehen. Ein Bereich mit beschränktem Zutritt ist ein Bereich, zu dem nur Wartungspersonal mit einem Spezialwerkzeugs, Schloß und Schlüssel oder anderer Sicherheitsvorkehrungen Zugang hat, und der von dem für die Anlage zuständigen Gremium kontrolliert wird.

Avvertenza Questa unità deve essere installata in un'area ad accesso limitato. Un'area ad accesso limitato è un'area accessibile solo a personale di assistenza tramite un'attrezzo speciale, lucchetto, o altri dispositivi di sicurezza, ed è controllata dall'autorità responsabile della zona.

Advarsel Denne enheten er laget for installasjon i områder med begrenset adgang. Et område med begrenset adgang gir kun adgang til servicepersonale som bruker et spesielt verktøy, lås og nøkkel, eller en annen sikkerhetsanordning, og det kontrolleres av den autoriteten som er ansvarlig for området.

Aviso Esta unidade foi concebida para instalação em áreas de acesso restrito. Uma área de acesso restrito é uma área à qual apenas tem acesso o pessoal de serviço autorizado, que possua uma ferramenta, chave e fechadura especial, ou qualquer outra forma de segurança. Esta área é controlada pela autoridade responsável pelo local.

¡Advertencia! Esta unidad ha sido diseñada para instalarse en áreas de acceso restringido. Área de acceso restringido significa un área a la que solamente tiene acceso el personal de servicio mediante la utilización de una herramienta especial,

cerradura con llave, o algún otro medio de seguridad, y que está bajo el control de la autoridad responsable del local.

Varning! Denna enhet är avsedd för installation i områden med begränsat tillträde. Ett område med begränsat tillträde får endast tillträdas av servicepersonal med ett speciellt verktyg, lås och nyckel, eller annan säkerhetsanordning, och kontrolleras av den auktoritet som ansvarar för området.

Prevent Electrostatic Discharge Damage

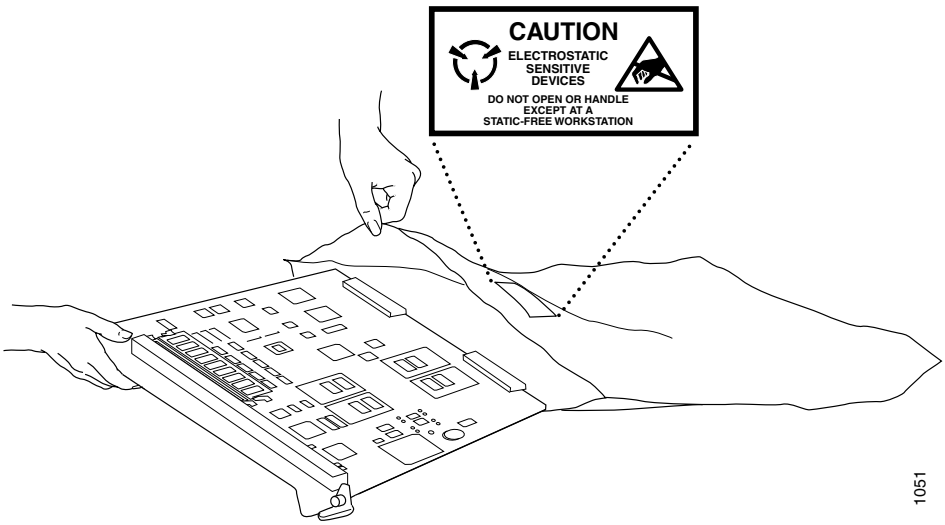
Many router module hardware components are sensitive to damage from static electricity. Some components can be impaired by voltages as low as 30 V. You can easily generate potentially damaging static voltages whenever you handle plastic or foam packing material or if you move components across plastic or carpets. Observe the following guidelines to minimize the potential for electrostatic discharge (ESD) damage, which can cause intermittent or complete component failures:

- Always use an antistatic wrist strap or ankle strap, and make sure that it is in direct contact with your skin.

CAUTION: For safety, periodically check the resistance value of the antistatic strap. The measurement should be in the range of 1 to 10 Mohms.

- When handling any component that is removed from the router module, make sure the equipment end of your antistatic strap is attached to one of the electrostatic discharge points on the router module, which are shown in Figure 1 and Figure 2.
- Avoid contact between the component and your clothing. ESD voltages emitted from clothing can still damage components.
- When removing or installing a component, always place it component-side up on an antistatic surface, in an antistatic card rack, or in an electrostatic bag (see Figure 21). If you are returning a component, place it in an electrostatic bag before packing it.

Figure 21: Placing a Component into an Electrostatic Bag



Electrical Safety Guidelines and Warnings

When working on equipment powered by electricity, follow the guidelines described in the following sections:

■ General Electrical Safety Guidelines on page 81

General Electrical Safety Guidelines

- Locate the emergency power-off switch for the room in which you are working, so that if an electrical accident occurs, you can quickly turn off the power.
- Do not work alone if potentially hazardous conditions exist anywhere in your workspace.
- Never assume that power is disconnected from a circuit. Always check the circuit before starting to work.
- Carefully look for possible hazards in your work area, such as moist floors, ungrounded power extension cords, and missing safety grounds.

Laser and LED Safety Guidelines and Warnings

Single-mode interface cards are equipped with laser transmitters, which are considered a Class 1 Laser Product by the U.S. Food and Drug Administration, and are evaluated as a Class 1 Laser Product per EN 60825-1 + A1 + A2 requirements.

Observe the following guidelines and warnings:

■ General Laser Safety Guidelines on page 82

- Class 1 Laser Product Warning on page 82
- Class 1 LED Product Warning on page 83
- Laser Beam Warning on page 83
- Radiation From Open Port Apertures Warning on page 84

General Laser Safety Guidelines

When working around interfaces, observe the following safety guidelines to prevent eye injury:

- Do not look into unterminated ports or at fibers that connect to unknown sources.
- Do not examine unterminated optical ports with optical instruments.
- Avoid direct exposure to the beam.

WARNING: Unterminated optical connectors can emit invisible laser radiation. The lens in the human eye focuses all the laser power on the retina, so even a low-power laser could permanently damage the eye if it is focused directly on the laser source.

Class 1 Laser Product Warning

WARNING: Class 1 laser product.

Waarschuwing Klasse-1 laser produkt.

Varoitus Luokan 1 lasertuote.

Attention Produit laser de classe I.

Warnung Laserprodukt der Klasse 1.

Avvertenza Prodotto laser di Classe 1.

Advarsel Laserprodukt av klasse 1.

Aviso Produto laser de classe 1.

¡Advertencia! Producto láser Clase I.

Varning! Laserprodukt av klass 1.

Class 1 LED Product Warning

WARNING: Class 1 LED product.

Waarschuwing Klasse 1 LED-product.

Varoitus Luokan 1 valodiodituote.

Attention Alarme de produit LED Class I.

Warnung Class 1 LED-Produktwarnung.

Avvertenza Avvertenza prodotto LED di Classe 1.

Advarsel LED-produkt i klasse 1.

Aviso Produto de classe 1 com LED.

¡Advertencia! Aviso sobre producto LED de Clase 1.

Varning! Lysdiodprodukt av klass 1.

Laser Beam Warning

WARNING: Do not stare into the laser beam or view it directly with optical instruments.

Waarschuwing Niet in de straal staren of hem rechtstreeks bekijken met optische instrumenten.

Varoitus Älä katso säteeseen äläkä tarkastele sitä suoraan optisen laitteen avulla.

Attention Ne pas fixer le faisceau des yeux, ni l'observer directement à l'aide d'instruments optiques.

Warnung Nicht direkt in den Strahl blicken und ihn nicht direkt mit optischen Geräten prüfen.

Avvertenza Non fissare il raggio con gli occhi né usare strumenti ottici per osservarlo direttamente.

Advarsel Stirr eller se ikke direkte p strlen med optiske instrumenter.

Aviso Não olhe fixamente para o raio, nem olhe para ele directamente com instrumentos ópticos.

¡Advertencia! No mirar fijamente el haz ni observarlo directamente con instrumentos ópticos.

Varning! Rikta inte blicken in mot strålen och titta inte direkt på den genom optiska instrument.

Radiation From Open Port Apertures Warning

WARNING: Because invisible radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to radiation and do not stare into open apertures.

Waarschuwing Aangezien onzichtbare straling vanuit de opening van de poort kan komen als er geen fiberkabel aangesloten is, dient blootstelling aan straling en het kijken in open openingen vermeden te worden.

Varoitus Koska portin aukosta voi emittoitua näkymätöntä säteilyä, kun kuitukaapelia ei ole kytkettynä, vältä säteilylle altistumista äläkä katso avoimiin aukkoihin.

Attention Des radiations invisibles à l'il nu pouvant traverser l'ouverture du port lorsqu'aucun câble en fibre optique n'y est connecté, il est recommandé de ne pas regarder fixement l'intérieur de ces ouvertures.

Warnung Aus der Port-Öffnung können unsichtbare Strahlen emittieren, wenn kein Glasfaserkabel angeschlossen ist. Vermeiden Sie es, sich den Strahlungen auszusetzen, und starren Sie nicht in die Öffnungen!

Avvertenza Quando i cavi in fibra non sono inseriti, radiazioni invisibili possono essere emesse attraverso l'apertura della porta. Evitate di esporvi alle radiazioni e non guardate direttamente nelle aperture.

Advarsel Unngå utsettelse for stråling, og stirr ikke inn i åpninger som er åpne, fordi usynlig stråling kan emiteres fra portens åpning når det ikke er tilkoblet en fiberkabel.

Aviso Dada a possibilidade de emissão de radiação invisível através do orifício da via de acesso, quando esta não tiver nenhum cabo de fibra conectado, deverá evitar a exposição à radiação e não deverá olhar fixamente para orifícios que se encontrarem a descoberto.

¡Advertencia! Debido a que la apertura del puerto puede emitir radiación invisible cuando no existe un cable de fibra conectado, evite mirar directamente a las aperturas para no exponerse a la radiación.

Varning! Osynlig strålning kan avges från en portöppning utan ansluten fiberkabel och du bör därför undvika att bli utsatt för strålning genom att inte stirra in i oskyddade öppningar.

Maintenance and Operational Safety Guidelines and Warnings

As you maintain the router module, observe the following guidelines and warnings:

- Battery Handling Warning on page 85
- Product Disposal Warning on page 86

Battery Handling Warning

WARNING: Replacing the battery incorrectly might result in an explosion. Replace the battery only with the same or equivalent type recommended by the manufacturer. Dispose of used batteries according to the manufacturer's instructions.

Waarschuwing Er is ontploffingsgevaar als de batterij verkeerd vervangen wordt. Vervang de batterij slechts met hetzelfde of een equivalent type dat door de fabrikant aanbevolen is. Gebruikte batterijen dienen overeenkomstig fabrieksvoorschriften weggeworpen te worden.

Varoitus Räjähdyksen vaara, jos akku on vaihdettu väärään akkuun. Käytä vaihtamiseen ainoastaan saman- tai vastaavantyyppistä akkua, joka on valmistajan suosittelema. Hävitä käytetyt akut valmistajan ohjeiden mukaan.

Attention Danger d'explosion si la pile n'est pas remplacée correctement. Ne la remplacer que par une pile de type semblable ou équivalent, recommandée par le fabricant. Jeter les piles usagées conformément aux instructions du fabricant.

Warnung Bei Einsetzen einer falschen Batterie besteht Explosionsgefahr. Ersetzen Sie die Batterie nur durch den gleichen oder vom Hersteller empfohlenen Batterietyp. Entsorgen Sie die benutzten Batterien nach den Anweisungen des Herstellers.

Avvertenza Pericolo di esplosione se la batteria non è installata correttamente. Sostituire solo con una di tipo uguale o equivalente, consigliata dal produttore. Eliminare le batterie usate secondo le istruzioni del produttore.

Advarsel Det kan være fare for eksplosjon hvis batteriet skiftes på feil måte. Skift kun med samme eller tilsvarende type som er anbefalt av produsenten. Kasser brukte batterier i henhold til produsentens instruksjoner.

Aviso Existe perigo de explosão se a bateria for substituída incorrectamente. Substitua a bateria por uma bateria igual ou de um tipo equivalente recomendado pelo fabricante. Destrua as baterias usadas conforme as instruções do fabricante.

¡Advertencia! Existe peligro de explosión si la batería se reemplaza de manera incorrecta. Reemplazar la batería exclusivamente con el mismo tipo o el equivalente recomendado por el fabricante. Desechar las baterías gastadas según las instrucciones del fabricante.

Varning! Explosionsfara vid felaktigt batteribyte. Ersätt endast batteriet med samma batterityp som rekommenderas av tillverkaren eller motsvarande. Följ tillverkarens anvisningar vid kassering av använda batterier.

Product Disposal Warning

WARNING: Disposal of this product must be handled according to all national laws and regulations.

Waarschuwing Dit produkt dient volgens alle landelijke wetten en voorschriften te worden afgedankt.

Varoitus Tämän tuotteen lopullisesta hävittämisestä tulee huolehtia kaikkia valtakunnallisia lakeja ja säännöksiä noudattaen.

Attention La mise au rebut définitive de ce produit doit être effectuée conformément à toutes les lois et réglementations en vigueur.

Warnung Dieses Produkt muß den geltenden Gesetzen und Vorschriften entsprechend entsorgt werden.

Avvertenza L'eliminazione finale di questo prodotto deve essere eseguita osservando le normative italiane vigenti in materia.

Advarsel Endelig disponering av dette produktet må skje i henhold til nasjonale lover og forskrifter.

Aviso A descartagem final deste produto deverá ser efectuada de acordo com os regulamentos e a legislação nacional.

¡Advertencia! El desecho final de este producto debe realizarse según todas las leyes y regulaciones nacionales.

Varning! Slutlig kassering av denna produkt bör skötas i enlighet med landets alla lagar och föreskrifter.

Agency Approvals

The router module complies with the following standards:

- Safety
  - EN 60825-1 Safety of Laser Products - Part 1: Equipment Classification, Requirements and User's Guide
- EMC
  - FCC Part 15 Class A (USA)
  - EN 55022 Class A Emissions (Europe)
  - AS/NZS 3548 Class A (Australia/New Zealand)
  - VCCI Class A (Japan)
- Immunity
  - EN 61000-4-2 ESD
  - EN 61000-4-3 Radiated Immunity
  - EN 61000-4-4 EFT
  - EN 61000-4-5 Surge
  - EN 61000-4-6 Low Frequency Common Immunity
- ETSI
  - ETS-300386-2 Telecommunication Network Equipment. Electromagnetic Compatibility Requirements

Compliance Statements for EMC Requirements

Canada

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

European Community

This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

United States

The router module has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Appendix B

Returning the Router Module

This chapter describes how to return the router module to Juniper Networks for repair or replacement:

- Tools and Parts Required on page 89
- Return Procedure on page 89

Tools and Parts Required

To remove the router module from the CBX 500 switch, you need the following tools and parts:

- Phillips (+) screwdriver, number 2
- Electrostatic bags or antistatic mats, one for each electronic component removed
- Electrostatic discharge (ESD) grounding wrist strap

Return Procedure

When you must return the router module, follow this procedure:

1. Determine the Juniper part number of the router module. This number is on the ID label on the front panel. It is the first of three numbers on the label and has the format 750-xxxxxx.
2. Determine the serial number of the router module. For instructions on locating the serial number, see “Locating the Serial Number” on page 90.
3. Obtain a Return Materials Authorization (RMA) number from the Juniper Networks Technical Assistance Center (JTAC). You can send e-mail to support@juniper.net, or call 1-888-314-JTAC (within the United States) or 1-408-745-9500 (from outside the United States).

   Provide the following information in your e-mail message or during the telephone call:

   - Part number and serial number of the router module

- Your name, organization name, telephone number, and fax number
- The shipping address for the replacement router module, including contact name and phone number
- Description of the failure

4. The support representative validates your request, and issues an RMA number for return of the component.
5. Pack the router module for shipment, performing the procedure described in "Packing the Router Module for Shipment" on page 90.

The following sections describe how to locate the serial number and pack the router module for shipment:

- Locating the Serial Number on page 90
- Packing the Router Module for Shipment on page 90

Locating the Serial Number

Your request for an RMA must include the part and serial number. Issue the CLI show chassis hardware command to list the numbers for all components installed in the router module:

```
user@host> show chassis hardware

Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                19250             IRM
Midplane         REV 03   710-010675   CD9653            IRM Midplane
Power Supply 0   REV 02   710-010673   CD9758            IRM DC Power Source
CB 0             REV 04   710-010671   CD9735            IRM Chassis Management
Routing Engine   REV 05   740-011105   1000526341        RE-5.0 (RE-400)
CFEB             REV 02   750-011103   CE2375            IRM CFEB
FPC 0                                                   E-FPC
  PIC 0          REV 04   750-011101   CE0392            2x OC-12 ATM-II IQ, SMIR
FPC 1                                                   E-FPC
  PIC 0          REV 06   750-011102   CD9620            2x G/E SFP, 1000 BASE
    SFP 0        REV 01   740-007326   P4Q0R0P           SFP-SX
    SFP 1        REV 01   740-007326   P550PV9           SFP-SX
```

The serial number is on the ID label on the front panel. It is the second of three numbers on the label and has five digits.

Packing the Router Module for Shipment

To pack the router module for shipment, follow this procedure:

1. Retrieve the shipping carton and packing materials in which the router module was originally shipped.

2. On the console or other management device connected to the router module, enter CLI operational mode and issue the following command to shut down the router module software. For more information, see the *JUNOS Protocols, Class of Service, and System Basics Command Reference*.

   ```
   user@host> request system halt
   ```

NOTE: Wait until a message appears on the console confirming that the operating system has halted.

   For more information about the command, see the *JUNOS Protocols, Class of Service, and System Basics Command Reference*.

3. Make sure that all LEDs are off except for the blue LED labeled MASTER. It is now safe to remove the router module from the switch.

4. Remove the cables that connect to external devices. For instructions, see "Replacing Fiber-Optic Cables" on page 57, "Replacing the Management Ethernet Cable" on page 63, and "Replacing the Console or Auxiliary Cable" on page 64.

5. Unscrew the mounting screws from the router module.

6. Move the router module to the shipping carton.

7. Replace the packing foam on top of the router module.

8. Close the flaps of the shipping carton over the router module and foam.

Appendix C
Cable Connector Pinouts

This chapter describes the pinouts for the following cable connectors:

- RJ-45 Connector Pinouts for the MGMT Port on page 93
- DB-9 Connector Pinouts for the AUX/MODEM and CONSOLE Ports on page 93

RJ-45 Connector Pinouts for the MGMT Port

The port on the router module labeled MGMT is an autosensing 10/100-Mbps Ethernet RJ-45 receptacle that accepts an Ethernet cable for connecting the routing engine to a management LAN (or another device that supports out-of-band management). For more information, see "Routing Engine Management Ports" on page 9. Table 12 describes the RJ-45 connector pinout.

Table 12: RJ-45 Connector Pinout

Pin	Signal
1	TX +
2	TX-
3	RX +
4	Termination network
5	Termination network
6	RX-
7	Termination network
8	Termination network

DB-9 Connector Pinouts for the AUX/MODEM and CONSOLE Ports

The ports on the router module faceplate labeled AUX/MODEM and CONSOLE are DB-9 receptacles that accept RS-232 (EIA-232) cable. The AUX/MODEM port connects the router module to a laptop, modem, or other auxiliary unit, and the CONSOLE port connects it to a management console. The ports are configured as data terminal equipment (DTE). For more information, see "Routing Engine Management Ports" on page 9. Table 13 describes the DB-9 connector pinouts.

Table 13: DB-9 Connector Pinout

Pin	Signal	Direction	Description
1	DCD	<–	Carrier Detect
2	RxD	<–	Receive Data
3	TxD	–>	Transmit Data
4	DTR	–>	Data Terminal Ready
5	Ground	—	Signal Ground
6	DSR	<–	Data Set Ready
7	RTS	–>	Request To Send
8	CTS	<–	Clear To Send
9	RING	<–	Ring Indicator

Part 5

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